Mining Journal

VOLUME 100 DECEMBER 4, 1915 NUMBER 23

Magnetic Separation in Sardinia

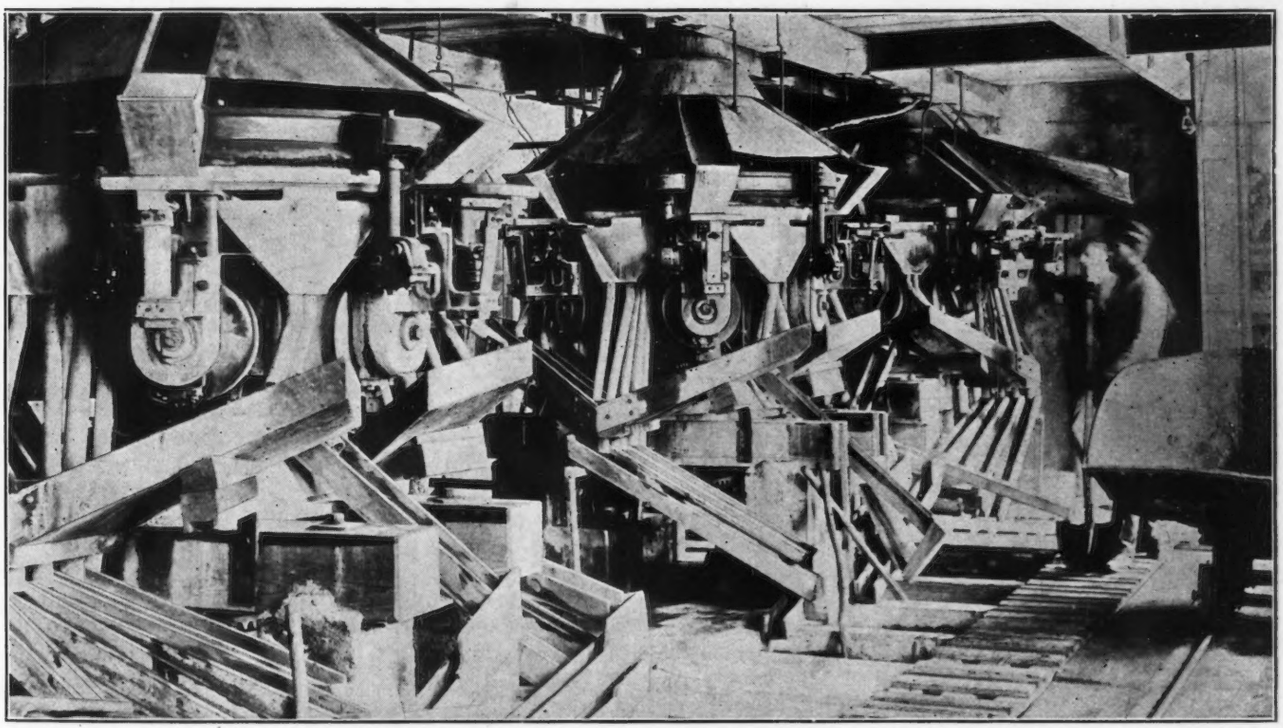
By Charles W. Wright*

SYNOPSIS—In order to improve the recovery at the Gennamari-Ingurtosu mine, Ullrich electromagnetic separators were installed. Results were immediately improved and have continued satisfactory. Description of the process and its cost are given.

The production of a high-grade blende concentrate from ores containing much siderite or pyrite cannot be accomplished satisfactorily by ordinary methods of milling. At most ore-dressing plants where such material is treated, a low-grade product or rich middling containing the blende and heavy gangue minerals is made in the jigs and on the tables. This product is first roasted or calcined so as to make the iron-bearing minerals more magnetic, and it is then separated by a magnetic separator. Such was the process employed until recently in the treatment of the blende-siderite ores at the Gennamari-Ingurtosu mine. The treatment costs, however, were high as well as the metal losses.

To improve these results a series of tests was carried out by the Elmore and Minerals Separation flotation processes, but only fair results were obtained, while the treatment costs were high. Tests were then made with the wet magnetic separators of the Electro-Magnetische Gesellschaft and with the Ullrich separators built by the Fried. Krupp Grusonwerk. The latter machines gave the best results and were therefore installed at our mill. They have now been in operation for over a year, and fairly accurate results as to their efficiency and costs have been obtained.

The occurrence of the blende-siderite ore at the Gennamari-Ingurtosu mine is in a lode that traverses a schistose country rock. This lode has been developed for 3 km. in length and averages from 3 to 15 m. in width. The blende ore is free from other sulphide minerals, and besides the siderite the gangue contains quartz, calcite and some barite, as well as a large amount of the altered schist. Portions of the lode contain well-defined veins, while other parts consist of a schist breccia, the ore forming the matrix. It is also noteworthy that the siderite occurs in greater quantities in certain parts of the lode and that



A ROW OF MAGNETIC SEPARATORS IN A SARDINIAN CONCENTRATOR

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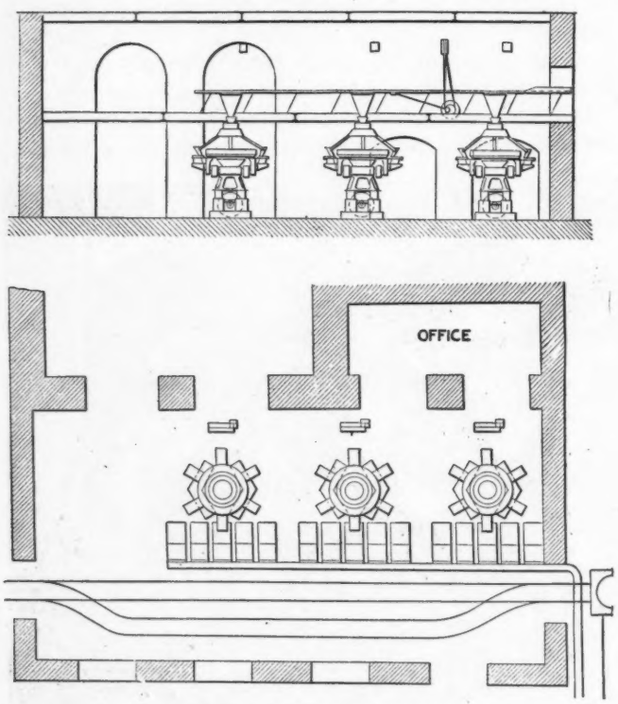
when possible the ore from these parts is mined and treated separately.

The ore from the mine averages from 10 to 15% zinc The richer ore is first treated on the *piazzale* by hand sorting and hand jigging to recover the coarse blende, and it is then sent to the mill for further treatment. The lower-grade ore goes direct to the mill. Here it is first reduced to 7 mm. and under, and then screened and 7 sizes made, 6 of which are treated in small four-compartment jigs, and that under 1 mm. size is treated on tables. The jigs produce a blende product, a rich middling of blende and siderite, which is sent to the magnetic separators, and a poor middling which is recrushed and retreated. Similar products are obtained from the tables. All of the rich middlings and in some instances the products containing an excess of siderite are sent to the magnetic-separator plant. The average tenor of the ore subjected to magnetic treatment is from 25 to 35% Zn and from 30 to 40% iron.

The former plant, used until last year for the separation of siderite from blende, consisted of an Oxland



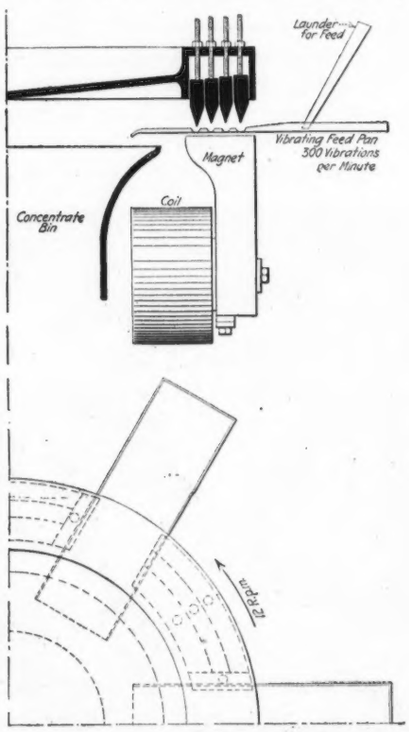
THE MAGNETIC SEPARATING PLANT

revolving calcining furnace and two dry magnetic separators of the Primosigh type. The capacity of this plant was about 1¼ tons per hr. The ore was first calcined in the furnace so as to reduce the siderite superficially to Fe_3O_4, thus making it more magnetic. The furnace was 10 m. long and had a diameter of 0.65 m. inside the firebrick lining. It revolved at the rate of one revolution in 2½ min. and had a capacity of 1½ tons per hr. The ore before roasting was mixed with 100 kg. of fine coal per ton. The total cost of calcining was 5 lire per ton. The Primosigh separators were in drum form, with electromagnets inside. Passing around this drum and over pulleys at the side were four wide belts. As the ore traveled along a shaking trough under, and at right angles to these belts, the siderite was drawn up on them and carried over the side of the shaking trough, while the blende continued to the end and discharged into a car. To operate the Primosigh separators, 5 hp. was required, and the cost of this separation was 2 lire per ton. The concentrates from the separators contained 50% zinc and 10% iron, and the tailings carried 6% in zinc and 45% iron, the zinc recovery being 93%.

The Reformed Electromagnetic Plant

The new magnetic separation plant consists of a series of three Ullrich magnetic separators arranged in tandem, shown in the illustration. The siderite-blende ore is fed by a bucket elevator to a Ferraris shaking screen, which separates the ore into 3 sizes—0-2, 2-4 and 4-7 mm. Each size is fed to one of the separators along with about 4,000 liters of water per ton of ore.

The Ullrich separators consist of a series of six electromagnets arranged in sextants of a circle. A half-section of the machine is shown in the drawing. Above these magnets are four iron rings which revolve, passing from the positive magnetic field of the first pole to the negative field of the second pole and then to the third pole, which



SYSTEM OF MAGNETIC CONCENTRATION

is positive, and so on, completing the circle in about 5 sec. Between the six electro-magnets and these rings, and traveling at right angles to the rings, are six brass shaking pans, on to which the ore is fed from a central distributor. As the ore passes into the magnetic field, the siderite is drawn up from the pan by the iron rings and is carried off the side of the shaking pan into a trough divided into two compartments. Some of the blende is dragged off of the pan and drops into the first compartment along with some siderite, and this constitutes the middling product, which is retreated. The siderite free from blende is carried forward on the ring to the second compartment, where it is washed from the rings by small jets of water. The blende free from siderite is discharged off the end of the shaking pans into a central launder.

To operate an Ullrich separator, about 1½ hp. is required for the mechanism and a current of 10 amp. at 125

volts is required for the magnets. The entire plant is operated by a 20-hp. motor. The plant runs 10 hr. per day and treats from 2½ to 3 tons per hr.

The ore fed to these separators averages about 34% zinc and 38% iron, the concentrates contain 53% zinc

COST OF PLANT OPERATION

	Lire per Day
Power, 20 hp. × 10 hr. × 0.07 lire	14
Labor, 4 men at 3 lire	12
Repairs, per shift	6
Supervision, per shift	3
Amortization, 70,000 lire in 10 years	27
Total cost per day	62
Cost per ton treated (25 tons per day)	2.48

and 5% iron, and the tailings carry 2½% zinc and 48% iron. The zinc recovery by this treatment is 96%, while 90% of the siderite is eliminated from the concentrates.

The total cost of the plant was 70,000 lire. The cost of operating is given in the accompanying table.

Injury to Mine Timbermen

By A. L. H. Street*

The Michigan Supreme Court was lately called upon to determine the liability of a mining company for injury to a timberman, caused by fall of rock, where he entered the place without looking and in advance of the usual announcement of the timber boss that it was safe to enter. (Vrelenich vs. Calumet & Hecla Mining Co., 154 Northwestern Reporter, 39.) The court holds that there can be no recovery under such circumstances; that the rule of law that requires an employer to use reasonable care to provide a safe place of work for his employees does not extend to the occupation of timbermen, for the very nature of their work is to make places safe for the miners to follow them. The employer's full duty to timbermen is discharged, the court declares, when reasonable rules are promulgated, the workmen are properly instructed, and when suitable tools and materials are furnished for the work, with competent men to perform it.

The fellow-servant rule was applied in a similar case by the same court (Kangas vs. Cleveland-Cliffs Iron Co., 154 Northwestern Reporter, 41). Plaintiff was a timberman working on a night shift and was injured through fall of a rock through a hole leading up into an old stope, and suit was brought on the theory of negligence of the day crew in not blocking up the hole. But recovery was denied on the ground that the members of the two crews were fellow-servants. The court expressly decides that it is not necessary, in order to constitute men "fellow-servants" within the rule in force in Michigan, exonerating an employer from liability for their negligence toward one another, that they be engaged in the common work at the same time. It is sufficient that they be engaged in the same work designed to effect the same general purpose.

Recent Scarcity of Monazite from Brazil, according to a consular report from Madras, has directed attention to the possibilities for commercial development of the large deposits of monazite sand in Travancore, South India. The production of monazite in British India in 1913 was valued at over $200,000. Most of the output was exported in a raw state. A European firm recently purchased land in South Travancore for the express object, it is said, of carrying on an export trade in monazite. It is now announced that under a recent order of the British Government the export of monazite sand from British India except to the United Kingdom is prohibited.

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Conservation of Mineral Resources*

For purposes of illustration and comparison the losses caused by the waste that conservationists hope to lessen or to eliminate are usually expressed in tons or in terms of monetary value, but as our individual ideas of the value of money vary widely, I should prefer to discuss these losses in terms of a labor-unit value. The statement that in certain industries a loss of $1,000,000 per day is caused by waste conveys vaguely the idea of great loss, but if we express this by stating that a loss of 500,000 days of labor is daily caused by waste, this statement conveys the same idea to all, namely, that the labor of 500,000 employees is wasted every day—a concrete statement of fact that gives a more definite conception of what waste really means, for going one step farther, we see that if this waste could be avoided we would immediately have available the labor of an army of 500,000 men, which could profitably be employed in other productive industries.

I have introduced this homely example because it directs attention to the value of labor as a national asset and as the real basis of our prosperity and the foundation of all wealth. The engineer should remember that the conservation of labor is more important than the conservation of coal or other resources which the Creator has furnished us in most abundant supply, for labor that is unnecessarily expended is an absolute loss and never can be regained.

Conservation of Labor the Great Aim

Conservation of labor is more important than any other economic issue and should be adopted as a governing principle of national policy. The object of the engineering sciences is to produce a given product or to accomplish the greatest quantity of work of any kind, with the least possible expenditure of labor. This is sometimes called engineering efficiency, but is more broadly described by the term conservation of labor.

I may perhaps make this meaning clear by a concrete example illustrating the aplication of the principle of conservation of labor to mining. If we assume that one ton of iron ore can be mined and prepared for shipment to the blast furnace from average mines at an average cost of one day's labor, it would be an economic waste to attempt to mine iron ore from deposits that require two or three days' labor per ton of ore produced, because by employing one day's labor at a mine of the first-mentioned class the same quantity of ore could be produced and two days' labor would be released for employment in other useful work; and it would be a similar economic waste to attempt to recover ore from the tailings or waste dumps of a mine of the first class, if the recovery of each ton of ore from this material required the expenditure of two or three days' labor.

The same principle of the conservation of labor may be applied to all mining and metallurgical industries, the rule being that labor is unwisely expended when the labor cost of producing any product exceeds the average labor cost at which the product can normally be produced.

*Excerpts from an address delivered by H. M. Chance at the dedication of the Mines Building at Pennsylvania State College, State College, Penn., Nov. 5, 1915.

I would now like to say a few words in defense of the coal-mine managers and engineers whom conservationists of the extreme type charge with wholesale waste in the mining of coal. The fact that many graduates of this School of Mines are now employed in coal mines justifies discussion of this subject in some detail.

Most of our bituminous coal is mined from coal beds that are nearly or quite horizontal, and it will easily be understood, even by those who never have visited a coal mine, that as the coal is removed some method must be provided for supporting the roof of the workings; that is, for sustaining the great weight of rocks that lie upon the coal and extend from the coal bed up to the surface of the ground. By what is known as the longwall system of mining some coal can be worked without supporting the roof, which is allowed to settle down and fill the space made by the removal of the coal, but in most mining districts the use of this system is not feasible and the roof must be supported to a greater or lesser extent as the coal is removed. Timber, structural steel and concrete or rubble masonry have been used for this purpose, but these materials are costly and therefore are used sparingly. At present prices the cost of timber, rubble masonry and concrete per cubic yard is respectively about $12, $4 and $6, while loose material such as sand or gravel, or broken stone (brought into the mine and used for the purpose of supporting the roof) will vary in cost in different localities, but will range usually from 75c. to $1.50 per cu.yd., plus the cost of timber or masonry necessary to confine and hold these loose materials in place.

To Waste Coal Is Sometimes To Save Labor

As the value of coal in the ground as measured by royalty rates is rarely greater than 10 or 15c. per ton, in using concrete or rubble masonry, or even loose materials to support the roof, the engineer must so design these supports that each cubic yard of material so used will permit of the mining of from 15 to 40 tons of coal, but this is rarely possible, as in most cases a cubic yard of masonry or concrete would be necessary for each 10 or 15 tons so mined. If this method were adopted the cost of the coal would be increased about 30c. per ton.

As it is obviously foolish and wasteful to use high-priced materials when other cheaper materials are available, the mining engineer has preferred to substitute in place of masonry for supporting the roof, certain portions of the coal bed itself, which by the plans for working the coal, are not to be mined but are to be left as pillars to support the roof, thus substituting in place of concrete or rubble masonry costing $4 or $5 per cu.yd., coal that has a nominal value (but no labor value because no labor has been expended upon it) of but 10 or 15c. per cu.yd. The coal left as pillars to support the roof is thus utilized and performs a necessary and useful function, yet the principal part (perhaps two-thirds) of the 200,000,000 tons our friends the conservationists claim is willfully and avoidably wasted every year is this coal that is left in pillars to support the roof. I think we can safely claim that this is not waste, but on the contrary is engineering efficiency of the highest type, in that it utilizes the cheapest and least valuable material available to support the roof and saves the whole labor cost of building supports of other materials.

Investigation as to what becomes of that part of the 200,000,000 tons claimed as wasted, that is not utilized as pillars to support the roof, will disclose the fact that a large portion is coal that is left in mine workings that are abandoned because the roof is unsafe and because a continuance of operation would result in injuries or loss of life. Coal left in the mines in order to conserve human lives cannot be classed as avoidable waste. A small part of the 200,000,000 tons is lost because it is intimately mixed with refuse and because the labor cost of recovering it and separating it from the refuse would be greater than its value.

Relative Values of Our National Assets

If we are to realize the full benefits of conservation, it becomes necessary to distinguish clearly between the relative values of the assets sought to be conserved, otherwise waste of the more valuable assets may result from the efforts to conserve those of less value. From an industrial and economic point of view our national assets may be grouped as to relative values in the following order:

1. The life of the workman.
2. Labor.
3. Capital (the accumulated products of labor).
4. Supplies needed for current consumption.
5. National resources—timber, minerals, water power, fish, animals, fertility of the soil, etc.

The acceptance of the principle of conservation as applied to human lives is shown by the extension of "safety-first" methods to nearly all industries. "Safety first" has always been the motto of the mining engineer. Most mine accidents are caused by unusual or unforeseen conditions, or by ignorant or careless workmen, or by lack of knowledge of what constitutes a dangerous condition. Mine accidents have rarely, if ever, been traced to a disregard of the safety-first principle by engineers.

Next in importance to the conservation of life, engineers have always placed the conservation of labor. In conserving labor by so directing its application as to secure the best results at the lowest labor cost, the engineer protects the capital invested in industrial enterprises and secures satisfactory profits as compensation for its use.

Capital is increased by conservation of the supplies carried in stock to meet the requirements for current consumption, and accumulated wealth grows principally from the surplus thus saved.

A proper regard for the conservation of our national resources is imposed upon the engineer by the ethics of his profession, and we can feel sure that this duty will be performed efficiently and conscientiously by the graduates of the Pennsylvania State School of Mines and of other similar institutions.

In preparing this brief discussion of the conservation of mineral resources in its relation to the work of the School of Mines, my object has been to present the subject in a form capable of being understood by the student at the very threshold of his entrance upon the study of engineering. A further object has been to furnish a reply to the exaggerated and misleading statements promulgated by conservationists—a reply which could be understood by those who are not familiar with mining and metallurgical work, and which would show by simple and logical arguments that the engineer should not risk human life, waste the labor of employees, risk the loss of the capital of his employer or waste materials or supplies by attempting to carry out in practice doctrines or theories based upon the teachings of conservationists of the extreme type.

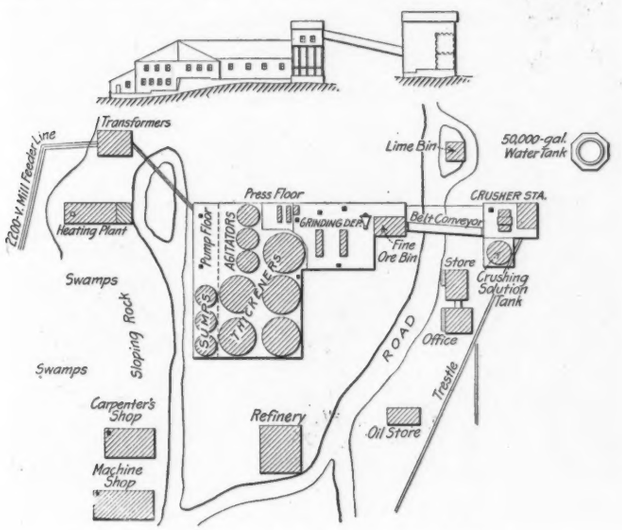
Building the Tough-Oakes Mill--II

By John A. Baker*

SYNOPSIS—Continuing the description and cost of the erection of the Tough-Oakes mill. The heating system, electrical motive-power machinery and equipment, piping and transmission machinery are discussed in detail. Finally, the metallurgical operation of the mill is described.

Since it is necessary to maintain a temperature of about 65°, the problem of economical heating during eight months of the year merits careful consideration. Low-pressure steam, using the gravity-return system, is employed. The boiler is of the inclosed-firebox type, designed for carrying 15 lb. of steam as a maximum. It is rated to supply 8,500 sq.ft. of steam radiation. The water level of the boiler is 5 ft. below the bottom of the lowest radiator in the mill. This factor is important if the radiators are to be kept free from water.

The boiler building has concrete retaining walls and floor. It is 15 ft. wide and 50 ft. long, with 12-ft. wall.



LAYOUT OF THE TOUGH-OAKES MILL

Included in this is a coal bin, 15x10x12 ft., at the eastern end of the building. The boiler setting is a combination of a brick arch and stone side walls lined with one course of brick. The stack is of steel and is 36 in. in diameter and 60 ft. high.

The total area of all radiators installed is 6,000 sq.ft. The total cubic contents of all buildings heated is 338,000 cu.ft. This gives a ratio of 1 sq.ft. of radiator surface to 56 cu.ft. of volume. This is over 10% less than the amount recommended by radiator manufacturers, but has been found ample, even in the severest weather.

The average coal consumption per day is about 2.5 tons, costing $10 per ton. With attendance, this amounts to $30 per day, or a total of $7,200 for eight months. In round figures, then, the heating of every 1,000 cu.ft. of building volume costs $50 per annum.

*Formerly Construction Engineer for Tough-Oakes Gold Mines, Ltd.

The total cost of installation, excluding boiler plant, is $13 per 1,000 cu.ft. Including boiler plant, the cost is $21 per 1,000 cu.ft. The detailed cost of the boiler house is shown in the accompanying table.

TABLE 6. COST OF BOILER HOUSE

	Labor	Material	Total	Labor in Cost	Supervision	Total
Clearing, excavation and foundations..	$222.60	$93.81	$316.41	70%	.....	.....
Building and erection	265.45	358.30	623.75	42%	.....	.....
Boiler setting and equipment	759.09	1313.70	2072.79	36%	.....	.....
Totals	$1247.14	$1765.81	$3012.95	41%	$198.95	$3211.90

The weight of the boiler, stack and trimmings complete was 14,000 lb. and the laid-down cost at the mill site was $1,140. Six thousand red brick at $22 per M and 400 firebrick were used in the setting. The main steam line is 7 in. and the water-return main 5 in. in diameter. The summarized cost of the heating system distributed among the various buildings is shown in Table 7.

TABLE 7. COST OF HEATING SYSTEM

Building	Labor	Material	Total	Labor in Cost	Supervision	Total Cost
Crusher station.	$109.77	$248.48	$358.25	31%	.....	.....
Cyanide plant..	731.45	2800.95	3532.40	20%	.....	.....
Office	14.58	43.44	58.02	25%	.....	.....
Storehouse	6.03	20.00	26.03	23%	.....	.....
Carpenter shop.	25.59	46.03	71.62	35%	.....	.....
Machine shop..	53.98	107.37	161.35	33%	.....	.....
Totals	$941.40	$3266.27	$4207.67	22%	$499.40	$4707.07

Floor radiators costing 19.5c. per sq.ft. are used in the crusher station, office and shops. In the cyanide plant, wall-type radiators costing 22.4c. per sq.ft. are employed on account of the limited floor space. Cost of maintenance is higher for this type than for the floor radiators. This statement may appear to be contradicted by the higher cost of labor in the crusher station. This is not the case, however, since the higher labor charge in this case is due to the extra work on the trench and box carrying the pipes between the two buildings.

Electrical Power Equipment

All power used on the property is supplied by the Charlton & Englehart Power Co. The transmission line is 28 miles long and carries 33,000 volts. The frequency is 60 cycles, and the voltage is stepped down to 2,200 at a central transformer station. From here, the mill feeder line of 000 copper 1,630 ft. long connects with the mill transformer station. All mill motors use 550 volts. There are two sets of outside lightning arresters, pole-mounted. Cedar poles 30 to 35 ft. long and not less than 7 ft. at the top were used, the maximum distance between poles being 120 ft. All pole fittings are galvanized, and poles are securely guyed and dead-ended. As the line crosses a low-lying area covered with muskeg, some difficulty was at first experienced in digging post-holes, owing to the surface water. The muskeg is about 2 ft. deep over a bed of impervious clay. A box, open at both ends, 36 in. square and 30 in. deep, was forced down through the muskeg to the clay. This sealed off the muskeg water and permitted the remainder of the hole to be dug with ease. The cost of the pole line is given in Table 2, and

also in Table 9 of detailed electrical costs. It is at the rate of $3,930 per mile.

At the mill transformer station the voltage is stepped down from 2,200 to 550 volts in a bank of three 150-kv.-a. single-phase Westinghouse transformers. Space is left for a second bank in the same building. A main oil-switch of 450-kv.-a. capacity with indicating wattmeter is placed on the secondary side of the transformers. From the switch the main circuit runs to the busses of the mill switchboard upon which are six plain disconnecting switches controlling the motor circuits. All 550-volt conductor used in the mill is cable and is placed in conduit. The data on the various circuits are shown in Table 8.

A 10-kv.-a. lighting transformer, 2,200 primary to 110 secondary, is connected directly to the high-tension bus bars. A separate meter and switch control the 110-volt side. The lighting mains run along the outside walls of the mill to two Crouse-Hinds distribution panels, one in the central portion of the cyanide plant and the other in the crusher station. From these centers, 12 separate lighting circuits control the group lighting. Tungsten lamps are used throughout. For general illumination in the cyanide plant, 600-watt nitrogen-filled tungsten lamps with ground-glass bulbs are employed. If properly erected, these lamps last 5 or 6 months. No arc lamps are used.

TABLE 8. MOTOR-CIRCUIT DATA

Circuit No.	Length Ft.	Wire Size	Conduit Size	Motors Hp.	R.p.m.		Driven Machinery
1	120	2	1¼	40	580	2	centrifugals, vacuum and triplex pumps.
				20	690		Low-pressure air compressor.
				15	1120	5	thickeners, 3 agitators, 4 diaphragm pumps.
2	125	2	1¼	10	890		Conveyor belt and lime elevators.
				10	890	2	Dorr classifiers and elevators.
3	280	2	1¼	50	580	2	crushers, elevator, trommel and skip hoist.
4	50	4	1¼	40	580		16x60 Hardinge ball mill.
5	20	00	2	100	580		5x20 tube mill.
6	20	00	2	100	580		5x20 tube mill.
Main Feeder	75	2 Circuits 250,000 C.M.		2½			All motors Total mill load.

Total shipping weight of all motors, transformers, starters, etc., 46,000 lb. Laid-down cost, 18c. per lb.

All motors are of the Westinghouse G.M. mill type. With the exception of the circuits Nos. 3 and 4, all machines are much underloaded. Conductor size permits of 25% overload on each machine on the circuit. All motors 40 hp. and over have panel-type starter and ammeter. Smaller machines have the standard starter. With this starter an asbestos-lined box with knife switch, starting and running fuses is used. The summary of the detailed electrical costs is given in Table 9.

TABLE 9. COST OF ELECTRICAL EQUIPMENT

Building	Labor	Materials	Total	Percentage of Labor	Supervision	Total
Crusher station	$65.60	$856.68	$922.28	7.1	.....	.....
Cyanide plant	559.09	5,789.03	6,348.12	8.7	.....	.....
Transformer station	171.17	3,508.15	3,679.32	4.7	.....	.....
Machine shop	70.02	194.00	264.02	26.9	.....	.....
Power line	420.16	712.00	1,132.16	38.0	.....	.....
Total	$1286.04	$11,059.86	$12,345.90	10.4	$760.45	$13,106.35

The total cost does not include the transformer building.

The number, size and cost of motors and transformers can usually be estimated at an early stage of mill design. In the case of the Tough-Oakes, the total laid-down cost was $8,282 The ratio between this sum and the total of Table 9 gives us 1.6, a useful factor for estimating purposes.

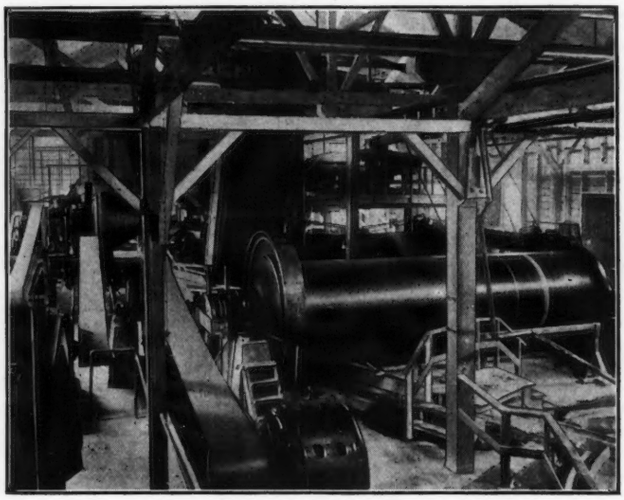
Estimating the amount of pipe that will be used in a mill is not so easy as might appear. While in no sense a standard, the exact bill of piping used in the Tough-Oakes should be of interest and is given here.

DETAILS OF PIPING ON THE PLANT

Size, In.	Amount Ft.	Price per 100 Ft.	Size, In.	Amount Ft.	Price per 100 Ft.
¼	51	3.00	2	1,900	9.90
⅜	102	3.50	2½	250	16.07
½	163	4.00	3	1,173	21.04
¾	880	4.25	3½	473	25.27
1	1,209	4.59	4	3,708	29.94
1¼	240	6.50	5	104	42.25
1½	1,430	7.42	6	150	54.45

These prices are for carload lots f.o.b. Swastika and are the lowest of several competitive bids. The foregoing list comprises all the pipe in the mill, whether water, solution, pulp or air, but it does not include the piping used in the heating system nor in connection with the refinery. It also includes the mill water-service pipe—a 4-in. line 1,200 ft. long.

All the thickener overflow pipes and main solution lines are 4-in. The 6-in. line is used on the gravity return from the presses to the No. 4 thickener. The large size is necessary on account of the small head available. Lunkenheimer all-iron clip gate-valves are used exclusively on all lines. Pipe work was started on Jan. 21 and completed Mar. 14. Five men composed the pipe-fitting gang. Wages were $3.25 for pipe fitters and $2.75 for helpers. A power-driven cutting and threading machine taking pipe up to 4 in. was available during the work.



REGRINDING DEPARTMENT

SUMMARY OF PIPING COSTS

Total cost of all pipe	$2,300
Total cost of valves	490
Total cost of fittings	600
Total cost of labor	1,050
Total cost of installation	$4,440

Of the total, labor comprises only about 24%. Valves and fittings cost about 50% as much as pipe. If we deduct the 1,200 ft. of 4-in. supply line containing almost no fittings, we get a figure of 60% for this ratio, which is nearer correct for straight mill work.

The mill water-supply line previously mentioned runs from the mine water tank to the mill water tank. For 100 ft. of its length the pipe lies in a box filled with sawdust. For 300 ft., rock cut was necessary to secure the required 4 ft. of cover. The balance is ordinary earth

excavation. Total cost for labor and material, from Table 2, is $2,291.58, or $1.91 per ft. This cost is rather high, as freezing weather was encountered before the work was completed. Under favorable weather conditions $1.70 per ft. could be achieved.

The mill water tank is 22 ft. in diameter by 20 ft. high, with sides and bottom of 3-in. British Columbia fir, and holds 50,000 Imperial gallons. It cost $464 f.o.b. Swastika. The bottom of the tank is 27 ft. above the ground. The substructure is of 10x10-in. timber on concrete piers. Costs are shown in Table 2.

Transmission Equipment and Machinery Installation

All bearings are of the ring-oiling type; split cast-iron pulleys are used throughout. A liberal factor of safety was allowed in all shafting, and the number of sizes used reduced to three—$1\frac{5}{16}$-in., $2\frac{7}{16}$-in., $2\frac{15}{16}$-in. The laid-down cost of all transmission equipment, excluding belting, was $1,534. Cost of belting was $2,050, making a total first cost for all transmission equipment of $3,584. Endless stitched rubber belts are used on all motor drives. All transmission and conveyor belting is of the best-quality rubber. Balata is used on the two elevators.

The data on piping and transmission already given are included under the heading of "Machinery and Equipment" in the main tabulation of cost given in Table 1. In fact, this account is a blanket one covering everything that could not be properly charged to any of the other work orders. Besides all machinery proper, it includes the initial charges of pebbles and balls, amalgamating tables, all launders, elevator housings, platforms and walk-ways, guard rails and labor incident to trying out and adjusting machinery before it went into regular operation.

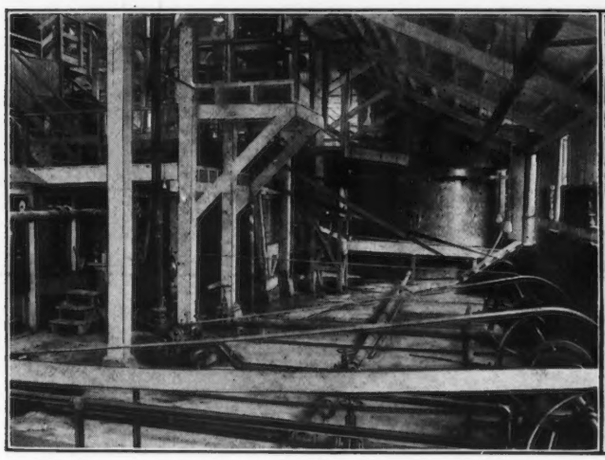
In the crusher station, labor forms 24% of the total; in the cyanide plant 17% and in the combined machinery installation, 18% of the total.

At the crushing station, floors and stairways were completed on Dec. 20 and machinery installation commenced on that date. The motor and shafting were turned over on Feb. 20 and the first rock was crushed on Mar. 8. The skip coming up the incline runs over a platform scale of 3 tons' capacity. The average weight of ore is 1.45 tons. The skip is then pulled up over a tipping device, and the empty skip acquires sufficient momentum in righting to carry it back over the 22 ft. of weighing platform and onto the down-grade, where gravity returns it to the shafthouse. A ½-in. cable is used. The trestle is 950 ft. long, with a 10% grade for two-thirds of the way and 4% for the remainder. The track is 26-in. gage, using 20-lb. rails. The average height of trestle is 12 ft. and the hoisting speed is 450 ft. per min.

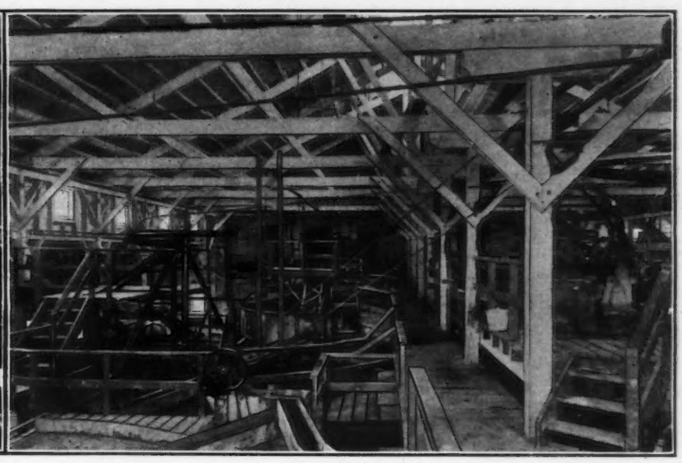
From the ore bin, holding 75 tons, the ore is drawn out through an arc gate into a 12x20-in. all-steel Buchanan jaw crusher set to 2 in. The product falls to a 14-in. 6-ply Balata-belt elevator with 12x7x7-in. manganese-steel buckets running 375 ft. per min. on 36-ft. centers.

The elevator delivers to a 30x60-in. Gates-type revolving screen running 20 r.p.m. and having 1½-in. round perforations in ¼-in. plate. The oversize of this screen returns to a 10x16-in. all-steel crusher set to 1⅛-in. with special smooth jaw-plates for fine grinding. The product from this machine drops to the same elevator and is returned to the screen. The undersize of the screen falls to a hopper, whence it is fed to the incline conveyor belt delivering to the cyanide-plant ore bin. This belt is 14-in. 5-ply rubber conveyor belting running at 125 ft. per min. on a 14° slope. It is driven by a separate motor.

The large crusher runs 250 and the small crusher 275 r.p.m. Each crusher is driven through a split friction clutch on a main lineshaft. Another clutch cuts out the countershaft driving the elevator, trommel and skip hoist.



PUMPING FLOOR, SHOWING ZINC FEEDER



INTERIOR OF THE TANK AND AGITATOR ROOM

The crusher station has a normal capacity of 15 tons per hr. and often makes 20 tons when all conditions are favorable. The ammeter of the 50-hp. motor driving this department springs between 35 and 45 amp.

Description of the Cyanide-Plant Arrangement

The crushed-ore bin is flat-bottomed and holds 165 tons when filled up to the conveyor discharge. Of this, 85 tons will run out by gravity. From three chutes along one side of the bin, the ore is delivered by eccentric plunger feeders to a 12-in. conveyor belt traveling 75 ft. per min. This belt spills into the scoop box of a 16x72-in. Hardinge ball mill running 30 r.p.m. and set with 2½-in. fall toward the discharge end. Sodium-cyanide solution titrating 2.5 lb. KCN per ton is added to the scoop box. The ball load is between 4 and 4½ tons.

Under these conditions the capacity of the mill has been found to be between 85 and 90 tons per 24 hr., using 40 to 45% moisture. A lower moisture gives a

finer product but less tonnage. With 55 to 60% moisture a large quantity of coarse oversize is thrown out. It is hoped that by leveling up the mill, decreasing the speed to 29 r.p.m. and using a choke plate to raise the ball load, a considerable increase in capacity will be obtained. On medium-grade ore, $20 to $25 per ton, tube mills and cyanide plant will handle 110 tons. A screen test of the ball-mill feed and discharge is shown.

SCREEN TEST SHOWING BALL-MILL WORK

Feed (Average of 3 tests)	%	Discharge	%
		On 2-mesh	7.3
On ⅜x1⅜	7.4	On 4-mesh	3.6
On 2-mesh	64.1	On 10-mesh	7.1
Through 2-mesh	28.5	On 20-mesh	20.2
		On 60-mesh	18.7
		On 150-mesh	15.2
		Through 150 mesh, sand	11.0
		Through 150 mesh, slime	18.2

The ball-mill discharge is split between two duplex Dorr classifiers, each 20 ft. long, but except for the extra 4 ft. of length, standard machines. The rakes are lengthened 6 in. to prevent fine sand banking near the overflow. They are set on a slope of 2¼ in. per ft. The sand coming over the head end gravitates to the feed box of a 5x20-ft. tube mill equipped with a scoop of 26-in. radius. Pebbles are fed through the scoop and the load is kept 4 in. above center.

Moisture is kept at 40% of the total. The mills are provided with cast-steel heads, manganese-steel head liners and cast-iron gears. The shell liners are chilled cast iron with concentric ribs known as the Globe type. A set of shell liners weighs 10,500 lb. Exact power-consumption measurements are not at present available, but the ammeter registers between 70 and 80 amp. under normal conditions. A 100-hp. motor drives each mill through a 72x18-in. clutch pulley, thus leaving a margin for the use of manganoid balls if found desirable. Pulley centers are 22 feet.

The discharge from either tube mill may return to its classifier or to a 12-in. bucket elevator which raises it to two amalgamated copper plates from which the pulp returns to the classifiers. Each plate is 5 ft. wide and 30 in. long. Longer plates were tried out, but as the bottom one caught no gold and became corroded from the action of the cyanide, it was discarded.

Classifying and Filtering the Pulp

The dilution in the classifiers is kept between 5 and 6 to 1, the specific gravity of the ore being 2.7. The primary, or No. 1, thickener is a standard Dorr machine of heavy pattern. It makes one revolution in 8½ min. The pregnant solution overflowing it carries $4 to $5 per ton on medium ore and runs by gravity to a clarifying filter box containing twelve canvas vacuum leaves. Each leaf is 9 ft. 6 in. by 4 ft. 6 in. When precipitating at 375 tons per 24 hr., an average rate, this gives 70 sq.ft. per ton per hr. Experience shows that an allowance of 100 sq.ft. per ton per hr. would be better on Tough-Oakes ore.

An 8x10-in. vacuum pump delivers the clarified solution to the 16x10-ft. pregnant sump. A tipping-box with a counter measures the tonnage going into the tank. A 5½x7-in. triplex pump, with connection to Merrill zinc feeder on the suction side, forces the solution through two 36-in. 16-frame Merrill presses. The barren effluent carrying 2 to 6c. per ton can gravitate to No. 1 agitator, No. 4 thickener, or the 16x10-ft. barren-solution sump.

The vacuum and triplex pumps are belt-driven from the pump-floor lineshaft, which also drives two 3-in. Gwynnes centrifugal slime pumps. These pumps run 1,600 r.p.m. and handle the crushing and barren solutions. The crushing solution, being the overflow of No. 2 thickener, runs to a 16x10-ft. sump and is elevated continually by the centrifugal to the upper 20x10-ft. storage sump. The barren-solution pump is used only intermittently and is cross-connected so that it is available for handling crushing solution. A small motor-driven low-pressure air compressor is located on the pump floor. It has a capacity of 217 cu.ft. of free air per min. to 25 lb.

Returning to the primary, or No. 1, thickener, the underflow is elevated by diaphragm pump through 4-in. suction pipe to the first agitator at 40% moisture. The pump is of the constant-stroke variable-speed type, with a normal speed of 25 pulsations per minute. It is driven from the main lineshaft running the full length of the building. This shaft is supported on boxing mounted on the sides of the central row of posts. From it are driven all thickeners, agitators, diaphragm pumps and the sump elevator.

Agitation and Continuous Decantation Systems

The Dorr agitators are 16 ft. in diameter by 12 ft. high, with 6 in. fall between each tank. The arms make two revolutions per minute. Air is introduced at the top. The piping permits either crushing or barren solution to be added to secure the desired dilution—in this case 2.75 to 1. Present practice is to add cyanide sufficient to bring the solution in the first agitator up to 3 lb. per ton, or 0.15% KCN. Adding a portion of the cyanide to the tube-mill circuit is contemplated. As the experimental work indicated high acidity, dry lime was first added to the fine-ore bin. Practice showed the acidity to be not nearly so great, and it was found better to add the milk of lime to the thickeners. A protective alkalinity of about 1 lb. per ton, expressed as NaOH, is employed. The agitators dissolve about $2 per ton on medium-grade ore. The washed pulp from the last agitator will assay $1.60 to $1.80 and the same product in the final thickener discharge, $1 to $0.80c. There is no material difference between the plus and minus 200-mesh material. The solution going to waste assays 15 to 20c. per ton, which at 37% moisture means 7 to 12c. per ton soluble loss. This will undoubtedly be cut down when time has given an opportunity to perfect all details of the metallurgy. Thorough mixing of the solution and pulp entering the decantation thickeners is absolutely essential. The underflow solution value is at times double that of the overflow. The mill has not been running long enough to give representative figures for pebble and ball consumption, cyanide loss and cost per ton. Approximate estimates for the latter two items are 1¼ lb. and 2 lb. per ton.

The raw precipitate is worth $35 per lb. It is acid-treated in a wooden tank and then melted in a tilting furnace, using a No. 400 crucible. The resulting bullion is 600 fine in gold and 250 fine in silver.

The Houghton Copper Co., Winona, Mich., reports that during 1914 the sinking of the winze below the 820-ft. level was continued and bottomed at the 1,020-ft. level. The 620-ft. level was run north 383 ft. The 1,020-ft. level was extended 397 ft. to the south of the winze and 334 ft. to the north of the winze, and some good copper ground was encountered on both sides. Expenditures amounted to $23,440 and liabilities exceeded current assets by $7,650 at the end of the year. A mill test is to be made of about 7,500 tons of accumulated rock from development work.

Callow Flotation Process*

SYNOPSIS—The Callow pneumatic process is the result of development and modification of former systems. Its operation is described. Different oils affect different ores in various ways, but there is nothing but actual experiment to determine what will happen. The theory is that the process is an electrostatic one.

Early in 1909 I did a great deal of work with the Macquisten flotation process and was instrumental in the tube-plant installation at the Morning mill, at Mullan, Idaho. This work was followed by a large amount of experimenting on the different kinds of existing flotation processes, the outcome of which was the development of the pneumatic process.

The first application of pneumatic flotation for the treatment of ore was made at the mill of the National Copper Co., at Mullan, Idaho. The plant went into operation about Apr. 10, 1914. The flow sheet is shown in Fig. 1. Since that date, the process has been adopted by nearly all the other mills in the Cœur d'Alenes treating lead and lead-zinc ores, notably the Gold Hunter, Morning, Hercules, Bunker Hill & Sullivan, Caledonia, Last Chance, Hecla and Standard. The same process, too, has since been adopted by the Inspiration Copper Co., the Arizona Copper Co., the Anaconda Copper Mining Co., the Magma and other copper companies, and by the Silver King, Daly-Judge, Dusquesne, and El Rayo mining companies, on lead, zinc and other ores.

The Callow Floating Apparatus

The various elements composing the Callow process are shown in Fig. 2. In the mixer *A*, operated by compressed air, the oil, air and water are mixed and emulsified. In cases where the oil, or frothing agent, can be fed into the crushing or grinding machine, this mixer, or Pachuca tank, can be dispensed with, the tube mill discharging direct to the separatory cell.

The initial or roughing separatory cell *B* consists of a tank about 9 ft. long and 24 in. wide, with a bottom inclined at from 3 to 4 in. to the foot. It is 20 in. deep at the shallow end and 45 in. deep at the other end. It may be built of either steel or wood, but wood is preferable. Fig. 3 shows the cell in detail. The bottom of the tank consists of a porous medium made of four thicknesses of loosely woven canvas twill, properly supported by a backing of perforated metal to prevent its bulging when under air pressure. Through this porous medium compressed air is forced by a blower. Porous brick or any other ceramic material that will give the necessary fine subdivision to the air may also be used. Some of these have been tried out, but for practical and mechanical reasons the loosely woven canvas twill seems to serve all purposes better than anything else.

The space underneath this porous bottom is divided into eight compartments, each connected by an individual pipe and valve with the main air pipe. By this means the air pressure to each compartment can be regulated (by throttling the valve) to correspond to the varying hydraulic head within the tank, and so as to discharge a uniform amount of air throughout the length of the bottom. A pressure of from 4 to 5 lb. is commonly used, each square foot of porous medium requiring from 8 to 10 cu.ft. of free air per minute.

Each longitudinal edge of the tank is provided with a lip and an overflow gutter for the reception of the froth discharged. The lower end of the tank is furnished with a spigot discharge fitted with a plug valve operated by a float, to maintain a uniform water level within the tank

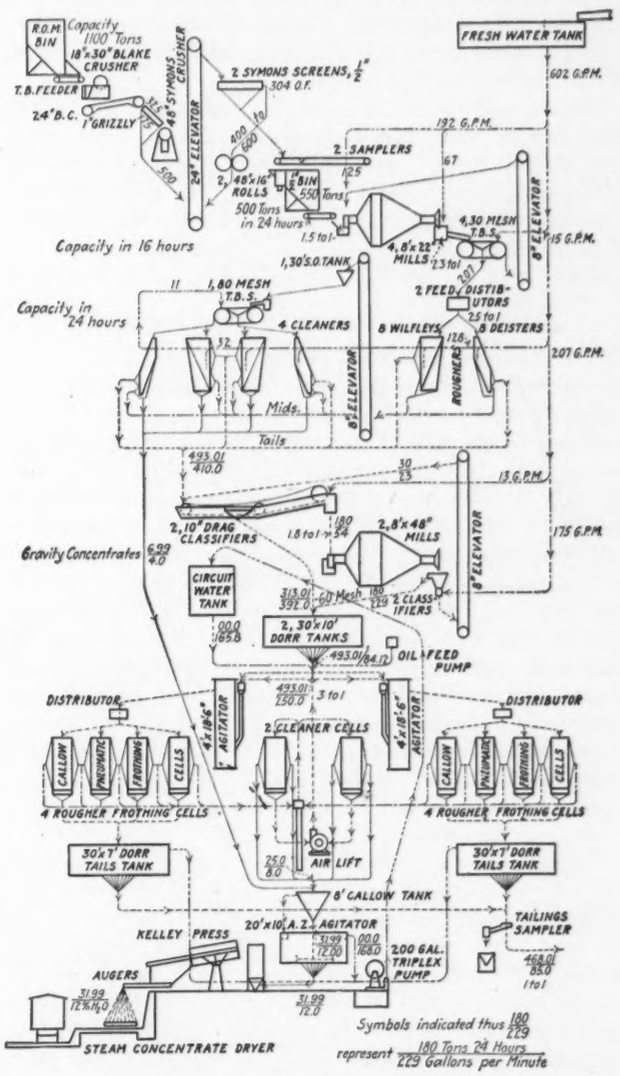


FIG. 1. NATIONAL COPPER MINING CO.'S MILL

and thus, in turn, maintain a uniform and constant discharge of froth under all the varying conditions of feed supply incident to practical milling operations. The water level may of course be varied, but is usually maintained at about 10 to 12 in. below the level of the overflow lips.

The tailings are discharged through the spigot, and the frothy concentrate is conveyed to the cleaner separatory cell *C*. This cleaner cell is a machine of the same construction as the rougher. In operation, however, it

*Excerpts from a paper by J. M. Callow, Salt Lake City, Utah, to be presented at the February, 1916, meeting of the American Institute of Mining Engineers at New York.

usually has a lower air pressure. The tailing from the cleaner is returned to the original feed, a closed circuit thus being maintained. The concentrate from the cleaner is the finished product.

The machines may be run either in parallel or in series without any sacrifice in the capacity for a given number of cells. Recent experience goes to show that on some ores the series treatment gives slightly cleaner tailings; on others it does not. It is not necessary to extend this arrangement of cells beyond two cells in series. In a heavily mineralized ore this arrangement is decidedly advantageous, and in such a case the rougher concentrate might be of high enough grade to dispense with the cleaning operation. The froth from the second cell in the series might be returned to the original feed, in the same way that the tailings are returned from the cleaner when practicing a roughing and cleaning operation. A number of such combinations are possible.

At the mill of the Inspiration Copper Co., Fig. 4, the feed goes to 12 primary roughers, the tailings from which are classified into sand and slime, the sand going to tables and the slime to 12 secondary roughers. The concentrate from both the primary and secondary roughers goes to four cleaner cells, and the tailings from the cleaner cells are pumped back into the circuit.

Froth Formation and Pulp Density

The froth is generated as the result of injecting the finely divided air into the bottom of the already emulsified pulp; it continues to form and to overflow as long as it is furnished with pulp of the proper consistency, adequately mixed with the right quantity and kind of oil or frothing agent. Measured from the water level within the tank, the froth produced may be from 14 to 16 in. thick and will be more or less voluminous, coarse or fine-grained, dry or watery, according to the character of the ore and the kind and quantity of oil introduced. The condition of the froth may be varied, therefore, by changes in the kind and quantity of oil used and the quantity of air injected. In some ores rich in sulphides, and where a comparatively low-grade concentrate will suffice, the cleaning cells may not be necessary, but on low-grade ores having a high ratio of concentration and when a concentrate of extreme cleanness and of maximum grade is required, a cleaner is desirable.

The pulp to be treated may be of varying density, from 2½ of water to 1 of ore, up to 5 or 6 to 1. For a mixture of sand and slime, the former ratio is preferable, but for pure slime, minus 200-mesh, the larger proportion of water is allowable. The particular density is not a matter of so much importance as the supplying of pulp of uniform density, since each variation in the density of the pulp requires a readjustment of the oil supply, the quantity of oil increasing in proportion to the increased volume of the pulp, independent of its solid contents.

The Oils Used and Froth Character

The oils used may be broadly divided into "frothers" and "collectors." The pine oils are good frothers, and coal tar and its various subdivisions are good collectors. On some ores crude pine tar will in itself combine the properties both of frothing and collecting; on others, this may have to be enriched by the addition of some one of its more volatile constituents, such as refined pine oil, turpentines, or wood creosote.

Generally speaking, the coal-tar products are poor frothers, and to get a sufficient volume of froth to insure a high recovery, it is often necessary to add refined or crude pine oil, creosote, etc. At the Inspiration mill, for instance, the mixture is 80% crude coal tar, 20% coal-tar creosote; at another plant on similar ore, 45% El Paso coal tar, 40% coal-tar creosote, 10% creosol and 5% pine oil. At Daly-Judge a mixture of 40% crude coal tar, 40% creosote and 20% pine oil was used. In the Cœur d'Alenes on zinc ore straight wood creosote was used; on the ore of the National Copper Mining Co., plain turpentine will work, but pine oil is better.

At Inspiration, from 1½ to 2 lb. of the mixture per ton of ore was used; at Daly-Judge, 1 to 1½ lb.; and at the National, $\frac{3}{10}$ lb. of oil is sufficient. In the experimental work at another plant the oil consumption was approximately 1 lb. of mixture per ton; but since the entire plant has been in operation, and the circuit water reclaimed and used over again, the oil consumption has dropped to 0.35 lb. At present the proper kind or kinds of oil and the quantity requisite can be determined only by experiment; no scientific way has thus far been found.

The stability of the bubbles depends to some extent upon the oil used and the nature of the gangue in the pulp

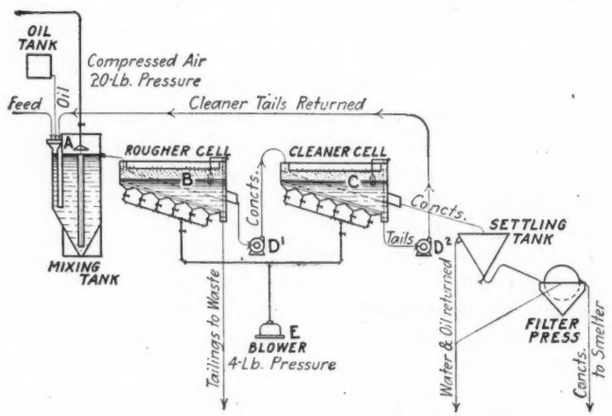


FIG. 2. CALLOW PNEUMATIC PROCESS

treated. Pine oil makes a brittle froth, which dies immediately on arriving at the surface. Creosote and light oil make a more elastic envelope, which at times will expand into bubbles 3 or 4 in. in diameter before bursting. Pine-oil bubbles are rarely over ¼ or ½ in. in diameter. Castor oil, olive oil, candle-makers' oil (oleic acid), palm oil, sperm oil and other oils of a lubricating nature have in general been replaced by oils more or less soluble or miscible in water—such as turpentine ,pine oil, and all the coal- and wood-tar distillations. The extremely volatile hydrocarbons, as naphtha, gasoline, ether and alcohol, seem to be of little use except as means for making the pitchy ingredients of coal and wood tars more soluble or miscible. A large, coarse and elastic bubble seems necessary to the recovery of coarse-grained mineral, but for the very fine and colloidal mineral, a small and comparatively brittle bubble is necessary.

The National Copper Mining Co., using approximately 950 cu.ft. of air at 4 lb. pressure, and treating 500 tons per day on eight roughers and two cleaners, required 35 hp.; this shows a requirement of 3.5 hp. per cell, equivalent to 12.53 tons per hp., or 1.25 kw.-hr. per ton.

Another company using approximately 9,600 cu.ft. of air at 5 lb. pressure and treating 2,400 tons per day on 48 roughers and 12 cleaners, requires 210 hp., equivalent to 3.5 hp. per cell, 11.45 tons per hp., or 1.56 kw.-hr. per ton. The experimental plant of the Inspiration Copper Co., using approximately 950 cu.ft. of air at 5 lb. pressure and treating 200 tons per day with four roughers and one half-size cleaner, required 24 hp.; deducting 4 hp. for two 2-in. centrifugal pumps, the figures become 4 hp. per cell, 10 tons per hp., or 1.79 kw.-hr. per ton. A maximum figure would be 2½ kw.-hr. per ton of feed, using 5 to 5½ lb. air pressure, generated by Roots or Connersville positive blowers.

The oil mixtures in use cost from 1.25c. per lb. up to 3c. per lb., depending on the percentage of creosol and other high-priced oils used; on most ores, 1½c. per lb. is a safe average figure, and a consumption of 1 to 1½ lb., or from 1.25c. to 4.5c. per ton of feed, averaging 2½c. would be a safe estimate.

Labor will vary, of course, with the size of the plant. At one plant consisting of 60 cells, two men per shift operate the entire plant, equivalent to a cost of 1¼c. per ton. One man per shift on a 250-ton plant means a cost of 5.4c. per ton. Assuming a life of three months per blanket, a capacity of 50 tons per cell, and an allowance for repairs to blowers, motors, pumps, etc., we have ½c. per ton as a liberal allowance.

With power at 1c. per kw.-hr., and a consumption of 2½ kw.-hr. per ton, the cost would figure 2.5c. per ton of feed. The estimated cost on a 2,000-ton flotation plant, or larger, would be approximately as shown in the table.

FLOTATION COST ON A 2,000-TON PLANT

	Per Ton, Cents
Labor	1.25
Oil	2.50
Maintenance	0.50
Power	2.50
Total	6.75

On a plant of 250 tons the extra labor costs per ton would bring it up to approximately 10c. per ton of flotation feed. Actual figures from a large plant treating over 2,000 tons by flotation gave 6.1c. per ton. The flotation feed in this case represents 60% of the crude-ore tonnage, making the cost 3.5c. per ton of crude ore treated.

The Reasons for Flotation Phenomena

So far no satisfactory explanation of flotation phenomena has been advanced. At my instigation and under my direction, a large amount of research work has been done in an endeavor to formulate some logical explanation of the phenomena, and perhaps to find some scientific way of conducting flotation experiments in place of the empirical methods now in vogue. Although the latter object has not yet been attained, still these experiments have resulted in the formulation of a theory that appears to be well grounded and that may prove of interest and value to others engaged in this art. This theory refers flotation ultimately to electrostatic action.

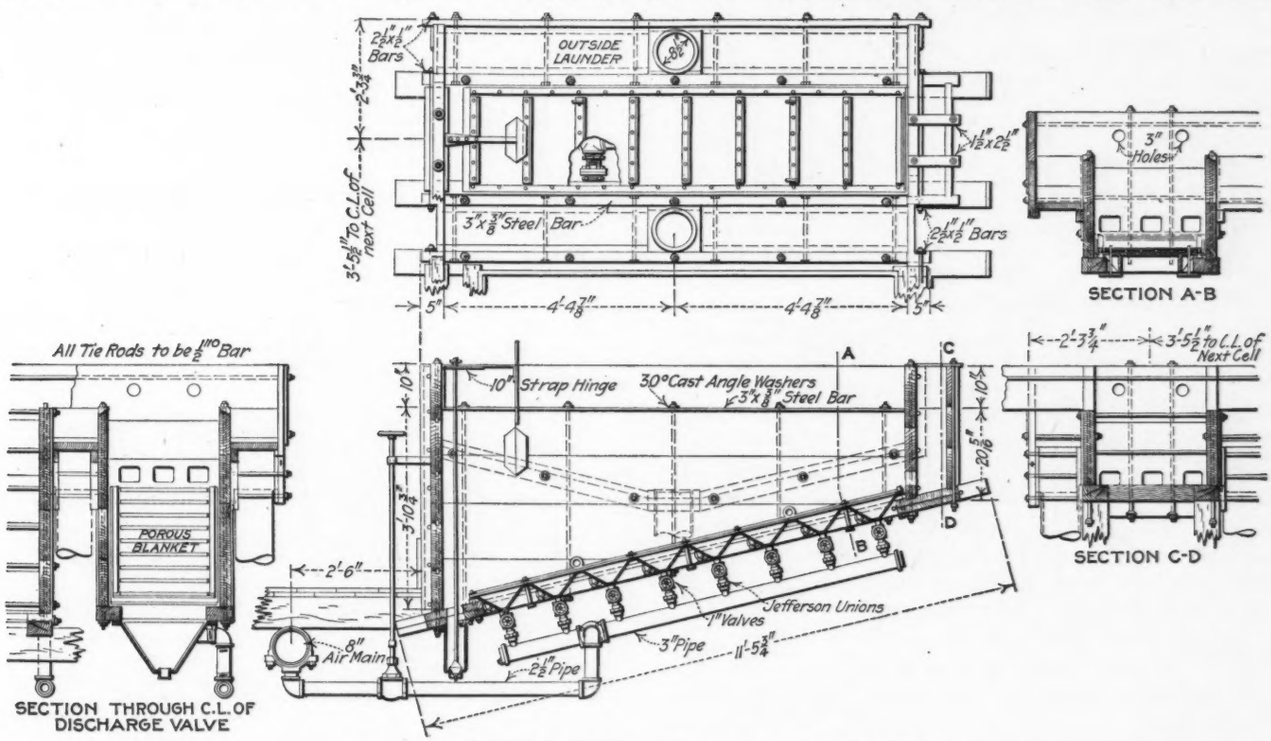


FIG. 3. DETAILS OF THE CALLOW FLOTATION CELL

Much work has been done at the Mellon Institute, at Pittsburgh, under the direction of Dr. Raymond C. Bacon, and lately by James A. Block at the station of the United States Bureau of Mines in Salt Lake City. The result of all of this work is summed up in the following statement:

In considering the connection between flotation phenomena and the physical properties of the minerals concerned, there are two parallelisms:

First—It has been noticed for some time that the minerals that floated were not easily wetted by water, while those that were easily wetted did not tend to come up with the froth.

Second—There is a parallelism beween certain electrostatic characteristics and the flotation properties of ores.

In the first-mentioned theory, surface tensions and contact angles should be considered. Certain minerals, such as galena, will float on the surface of still water, while gangue particles, since they possess a greater adhesive attraction for the water than the water's cohesive attraction for itself, will be drawn through the surface film into the interior, and sink because of their greater specific gravity. These properties of floatable minerals and gangues are increased by the presence of oil and acid. Oil sticks to galena with greater tenacity than it does to silica, and an oil surface is still less easily wetted than a galena surface. The acid in the water causes a still greater

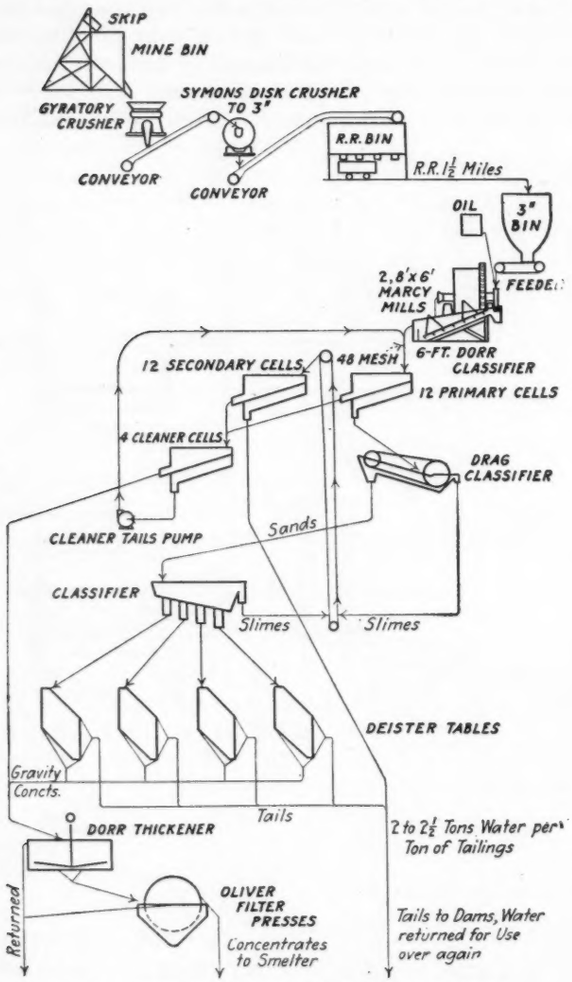


FIG. 4. INSPIRATION COPPER CO.'S MILL

difference in the various surface tensions. This, it seems, is without question the explanation of the action in the Macquisten process, in which the ore particles are lifted to the surface where they can be removed by skimming off the surface layer of the liquid.

With reference to the second parallelism, it has been noticed that extremely small amounts of certain colloidal impurities, such as saponin or tannin, were detrimental to flotation; while others, such as Congo red and methylene blue, did not interfere and were, if anything, beneficial. In classifying these, the injurious ones generally came under the head of what physical chemists call electronegative colloids, while electropositive colloids were not harmful. Suspended particles will generally migrate when placed in an electric field, and this classification comes naturally from the direction of their migration. This migration is called electrophoresis, or electrical endosmose, and is the result of the formation of contact layers around the particles by the liquid containing them, very similar to the formation of surface films when liquids come in contact with air. These contact films almost invariably have a difference of potential between their inner and outer surfaces. An air-water contact film has, for instance, a difference of 0.055 volt, and other contact films have similar charges. This causes the particles to act like charged solids and to be attracted by electric charges of opposite sign.

The charges on solids and nonmiscible liquids can be conveniently studied on the stage of a microscope.

This work naturally led to the study of the charges exhibited by various ores and minerals, and in that work an interesting parallelism was observed—namely, that floatable minerals seemed to have positive charges and non-

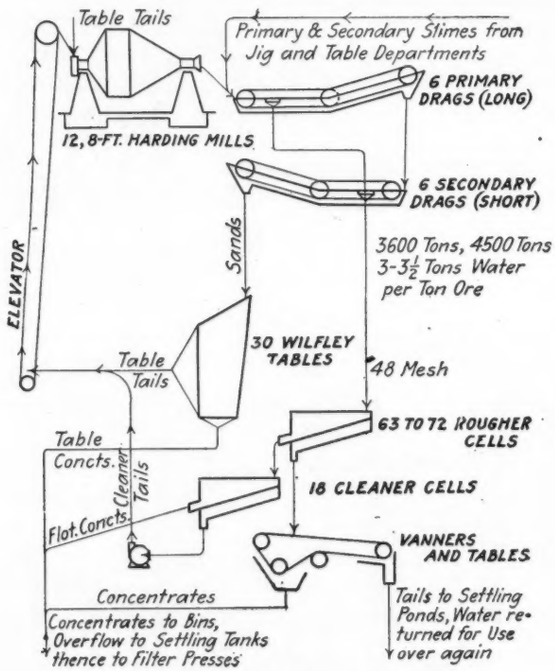


Table Tails
Primary & Secondary Slimes from Jig and Table Departments
6 PRIMARY DRAGS (LONG)
12, 8-FT. HARDING MILLS
6 SECONDARY DRAGS (SHORT)
ELEVATOR
Sands
3600 Tons, 4500 Tons 3-3½ Tons Water per Ton Ore
30 WILFLEY TABLES
Table Tails
48 Mesh
63 TO 72 ROUGHER CELLS
Table Concts.
Cleaner Tails
18 CLEANER CELLS
Flot. Concts.
VANNERS AND TABLES
Concentrates
Tails to Settling Ponds, Water returned for Use over again
Concentrates to Bins, Overflow to Settling Tanks thence to Filter Presses

FIG. 5. ARIZONA COPPER CO.'S MILL

floatable gangues, negative charges. Some gangues were found with positive charges, but they were characteristically hard to handle, having a tendency to come up with the froth. These charges sometimes vary with the acidity or alkalinity of the liquid, and this variation is not inconsistent with the effects of acidity or alkalinity on the flotation of ores.

It has been noticed that these electrostatic properties depend on the condition of the surface of the particle and not upon the composition of the mass. For instance, lead oxide, which is ordinarily negative or neutral, when covered with a sulphide coating takes upon itself a positive charge.

Effect of Contact-Film Charges

Recent investigations on the coagulation and deflocculation of slimes, on the coagulation and dispersion of colloids and along similar lines show that these contact-film charges, although small, have an important bearing on the dispersion or coherence of particles suspended in liquid mediums. In fine suspensions and in colloidal solutions, these charges may often be neutralized by the introduc-

tion of oppositely charged ions, precipitation generally taking place whenever these charges fall below certain limits. Oppositely charged contact films have a general tendency to coalesce, while similarly charged films, if their charges are great enough to overcome natural cohesiveness, do not seem to coalesce, but to repel each other, and if the weight of the particles is small enough in relation to their size and surface, permanent dispersion will take place, the particles distributing themselves through a liquid in much the same manner that gas will fill a container.

In view of the above observations, it seems possible that flotation is the result of difference in polarity in the

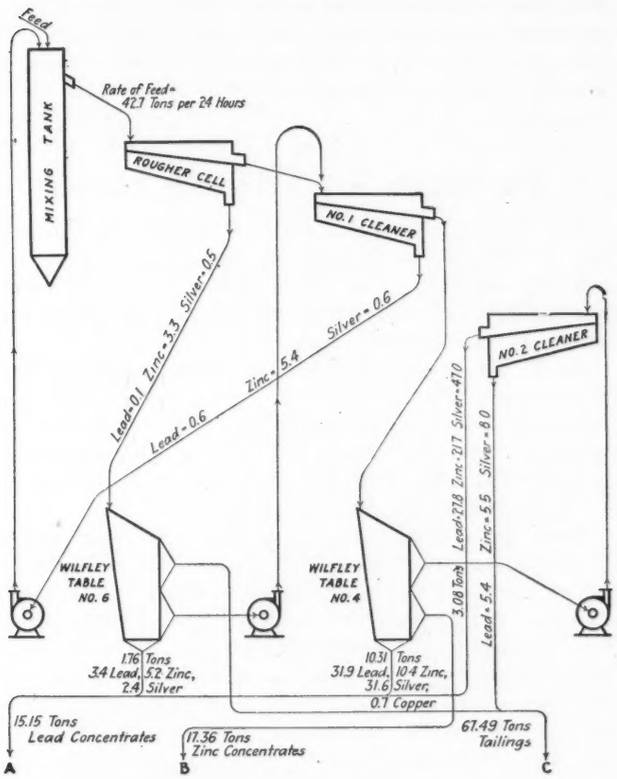


FIG. 6. FLOTATION AT THE DALY-JUDGE MILL

A	B	C
27.8 Pb = 84.95% total lead	3.9 Pb = 13.82% total lead	0.1 Pb = 1.37% total lead
12.1 Zn = 18.07% total zinc	42.4 Zn = 72.61% total zinc	1.4 Zn = 9.32% total zinc
31.4 Ag = 47.27% total silver	27.8 Ag = 48.02% total silver	0.7 Ag = 4.71% total silver
18.5 Fe	1.95 Cu	
4.0 Insoluble	7.9 Fe	
	3.2 Insoluble	

charges on the various ore particles and on the bubbles. Since oil contact films and air contact films have both been proved to have negative charges, the positively charged minerals will adhere to either. The bubble mantles in a flotation machine are undoubtedly composed of oil or of oil in emulsion, since pure water alone will not froth. The same forces, then, that cause oppositely charged colloids to agglomerate and precipitate, cause the minerals to adhere to the oil-covered bubbles; and the same forces that keep the particles of an oil emulsion dispersed, keep the gangue particles repelled from the bubbles.

Expressed briefly, the theory is as follows:

That oil flotation is an electrostatic process. It is a scientific fact that when a solid particle is suspended in water, the water will form around the particle a contact film which generally possesses an electric charge, the amount and polarity depending upon the nature of the surface of the particle and the electrolyte in which it is suspended. The presence of these charges can be demonstrated by the fact that the particles possessing them will migrate when placed in an electric field. It has been demonstrated that floatable particles have charges of one polarity (positive), and that nonfloatable particles have charges of the opposite polarity (negative); that the froth is charged negatively and so attracts the positively charged or floatable minerals and repels the negatively charged or nonfloatable ones. It is this, it is believed, that causes the floatable minerals, galena, sphalerite, etc., to adhere to the froth, and the gangue minerals, silica, etc., to remain in the liquid where they can be discharged as tailings.

A Word from Russia*

I finally left London on Apr. 5. I had been prepared to start on Mar. 19, but a few days before that, the wound in my leg, which I had received in the Caucasus, began to trouble me. It grew a little more painful every day, until on the 18th I consulted a surgeon, who said that an abscess was forming where the bullet was still lodged Consequently, I had to go into a hospital for an operation to have the bullet removed. This delayed me practically two weeks.

After I had reached Petrograd, I stayed there 10 days on business and then went to Moscow for a two-day visit. From there I went to Batoum and thence to our establishment at Danzoul, 40 mi. farther south. The Turks had voluntarily retired from the vicinity of our property early in March, on account of their rear being threatened. Much to my surprise, they had done no great material damage to the works. It is nothing short of marvelous that they had not done so. The local natives, however, had looted all of the private houses and had stripped them absolutely bare. The upholstered furniture and mattresses, which they did not wish to carry away with them, had had their coverings torn off. The only personal belonging that I recovered was the Brunton compass presented to me by the boys at the Braden mine. This had been found by a Russian soldier on a mountain side several miles distant from my house, where it had evidently been dropped unintentionally.

Besides looting the houses, the natives had done much willful damage to them—some not having even a door or window left. At the mine, as well as the reduction works, the warehouses had been looted. They had taken about 10 tons of explosives, all hand tools and instruments of every description, in addition to such material as leather and vanner belts. But this is all as nothing compared to what they might have done with a few matches or with a few boxes of dynamite. It is true that before going away they placed several mines, including two under my house; but these were probably for future use.

The collecting again of a staff and the making of the necessary repairs will be a big undertaking. However, nothing can be done until the Dardanelles is opened and the war with Turkey as good as settled. Fortunately, all of the old staff members whom I would want to re-

*Excerpts from a letter from R. T. White, of the Caucasus Copper Co., reprinted from "Teniente Topics." The letter is dated May 16, 1915, and sent from Tiflis.

engage, are anxious to return; but now there is very little labor available, and besides, general conditions are not such that we could do anything at the present moment.

Two weeks ago the commandant of the province of Batoum issued orders that all foreigners should be excluded from the district; so for the present I am obliged to stay in Tiflis, where I am simply waiting to see what is going to turn up next. I am in hopes that the order will be sufficiently modified within a few days so that I can return to Danzoul.

The St. Paul Electrification

C. A. Goodnow, assistant to President A. J. Earling, of the Chicago, Milwaukee & St. Paul Ry., in charge of the electrification work, states concisely the following advantages to be expected from electrification:

Our new electric locomotives have a capacity for hauling 3,200 tons on a 1% grade, while the maximum capacity for one of our steam locomotives on a 1% grade is 1,900 tons. In other words, our trainloads can be increased about 68% by electrical operation.

A Mallet steam engine costs 15c. to 25c. per mi. for repairs, while repairs to our electrical engines, so far as we can judge, will approximate 4c. per mi.

The first stretch of track on which electric engines will be put in service Dec. 15 comprises only one division—from Deer Lodge, Mont., to Three Forks. When the second division—from Three Forks to Harlowton, Mont.—is completely electrified we shall be able to judge how much the company will save from the reduction of interdivision expense. This will be a very considerable item. A steam locomotive, in common railroad practice, is not run through from one division to another. At the end of the division a steam engine must be cleaned and overhauled. The flues may be leaking, a cylinder may be hot or the firebox may be out of order—all reasons why it is impractical to run a steam engine from one division to another. An electric engine, on the contrary, may safely be run indefinitely without being laid up at division points.

Through what is called regenerative braking, moreover, a train on the down-grade is made to return for subsequent use 21% of the electric power required to move a train of similar tonnage up the same grade. This was proved in tests which I witnessed on the Butte, Anaconda & Pacific electrified railroad.

By electrification we eliminate fuel trains carrying company coal, and we do away with the necessity of maintaining wayside coal and water stations and cinder-pit expense.

Flotation at Idaho Springs

The Oneida-Stagg Mining and Milling Co., of Idaho Springs, Colo., is planning additional development calculated to open up more ore and facilitate the handling of orebodies now available. The mill, which was originally designed to treat ore by the continuous-decantation system of cyanidation, has been remodeled and is now equipped to treat 50 tons a day by oil flotation. It is estimated that the milling cost is about 85c. per ton. The cost of the oil is reported to be about 3c. per ton of ore treated.

The ore is delivered to a grizzly, the fines passing to the mill bins and the coarse to a Beales crusher and thence to the bins. The ore is delivered automatically to the stamps, and the pulp from the stamps passes to the concentrating tables. The concentrates are delivered to storage bins by a screw conveyor. The middlings pass to a Dorr thickener. Slimes and sands are delivered to a Dorr classifier, from which the sands go to waste and the slimes to a Dorr thickener.

The feed for the flotation machine is taken from the thickener, and the oil is added before the feed reaches the machine. The concentrates from flotation join the table concentrates on the screw conveyor. The surplus water from the conveyor and the tailings from the flotation machine are returned to the Dorr thickener. The concentrate bin is provided with a steel floor covering steam pipes, so that the concentrates may be relieved of moisture before shipping.

Revision of Mining Laws

The Utah chapter of the American Mining Congress has recently proposed that mining men of the West who are unable to visit Washington on Dec. 16 should ask the heads of their companies in New York to send somebody to represent them.

E. B. Kirby has made the excellent suggestion that mining men who are unable to attend should send brief telegrams expressing their opinion, to be read in the convention. Such telegrams, if sent on Dec. 14 or 15, should be addressed to F. F. Sharpless, secretary, in care of the U. S. Bureau of Mines, Washington, D. C.

Both the secretary of the Mining and Metallurgical Society and the Director of the United States Bureau of Mines have received many inquiries from oil men and coal men with regard to consideration of revision of the laws pertaining to oil and coal lands. The purpose of the forthcoming convention is especially to urge revision of the laws applying to metalliferous deposits. However, the position of the mining societies is that the mining laws should be revised in whole, not merely in part, and if it be shown that the laws governing coal lands, oil lands, etc., should be correlated with those governing metalliferous deposits, the contention will probably receive a hearing.

The headquarters of the convention will be in the Raleigh Hotel. The management of that hotel has granted special rates to members of the convention. Representatives attending should establish their membership by registering promptly.

It has been impracticable to secure any special railway rates on account of the small number attending from any one city, but a special Pullman will be run from New York over the Pennsylvania R.R. for the accommodation of members and delegates. This will leave the Pennsylvania Station, New York, at 12:30 night, Dec. 15, arriving in Washington at 7:10 a.m. The car will be open after 10 p.m. The corresponding Pullman will leave Washington at 12:30 night, Dec. 16, arriving in New York 7:13 a.m., Dec. 17. Anyone desiring reservations on either of these trains is to notify the secretary, F. F. Sharpless, 52 Broadway, as soon as possible.

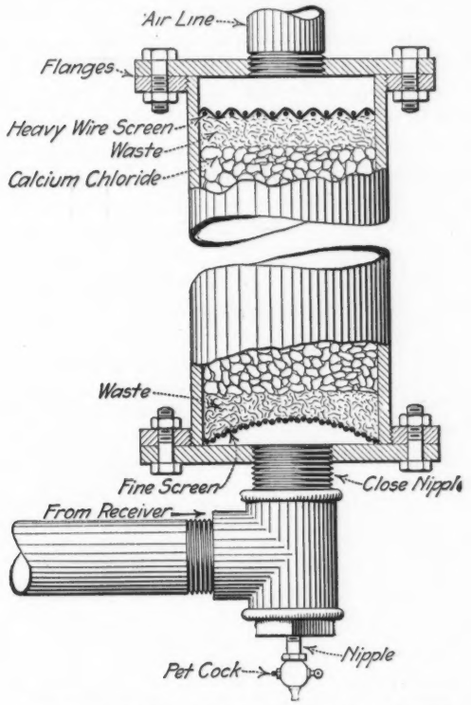
Coal Deposits on the Danish Island of Bornholm are being investigated by Danish and Swedish engineers with a view to their commercial exploitation.

Details of Practical Mining

Dryer for Compressed Air

By Charles Labbe*

Trouble is sometimes experienced with the moisture contained in compressed air. It rusts pipes, joints and valves and results in the latter frequently sticking and freezing. This trouble can be eliminated if the air be passed through a dryer containing calcium chloride or some other deliquescent material. A simple installation is the following, which may be made entirely of pipe fittings, available at nearly every mine: Use a piece of 6- or 8-in. pipe 3 or 4 ft. long (I used a 6-in. pipe, 4 ft. long, for a 10x12-in. compressor) and on each end screw



DRYER FOR COMPRESSED-AIR LINES

a flange to which is bolted a 2-in. flange or other size to fit the air main. At the bottom of the main chamber (the 6- or 8-in. pipe) place a concave wire screen (I used a 24-mesh screen over which was placed about 1 in. of cotton waste to keep the calcium chloride from running through). Next fill the chamber with calcium chloride to within about 3 in. of the top, then 1 in. or less of cotton waste, so that none of the salt will be carried into the piping, and place a heavy wire screen (about ¼-in. mesh) over the waste to keep it in place. At the lower part of the dryer a tee is connected by means of short nipples to the dryer flange and to a pet-cock which may be used as often as desired for draining. The dryer should be connected on the outgoing pipe of the air receiver. The calcium chloride has to be replaced from time to time, but this may be readily done by removing the flanges.

*Nelson, Nev.

Tempering Piston-Drill Bits

In a series of comparative tests of piston-drill bits made at the School of Mines, University of Missouri,[1] the following method was tried for tempering drill bits, and better results were secured than with any other method.

The graphite crucible containing a small quantity of salt (NaCl) was placed on the forge and the salt melted. The melting point of salt is about 800 deg. C., which is slightly above the critical temperature of the drill steel used. The steel to be tempered was placed on end in the crucible, the molten salt covering the bit to a depth of about 1½ in. The steel was left in the salt until, on removing, the salt no longer clung to it; in other words, until the steel had reached the temperature at which salt melts. The salt itself got considerably hotter than its melting point, but by watching the steel carefully, it was possible to remove it almost immediately after it had attained the proper temperature.

The steel was plunged directly into a bucket of freshly drawn water. The temper obtained in this manner was believed to be as nearly uniform as it would be possible to get with any method without the use of much more elaborate apparatus. The bits were hard and tough and stood up remarkably well. It was not uncommon to drill from 12 to 15 ft. in hard granite with one piece of steel which certainly indicated a good temper for the bit.

Getting Powder to the Miner

Different schemes have been observed for furnishing the miner with powder. In some mines a special blasting shift is put on. Undoubtedly powder can be saved in this way, as the greater experience these men get in treating the ground in question fits them to judge more accurately the minimum amount of powder necessary.

It is less complicated, though more wasteful of powder, to have a man find out from the miners at the beginning of the shift the amount of powder and primers they will need. This information he sends to the surface where the various orders are made up in the powder house. Toward blasting time the orders are sent below in gunny sacks to an underground magazine where each miner or his helper can get his own as shown by his employee's number on the sack.

Sometimes enough powder is kept underground and each miner sends his helper to the magazine for what he needs.

The Kv.-A. Convention

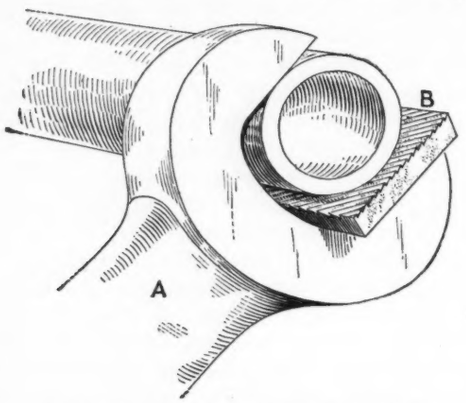
In alternating-current work there is generally a lag between the current and the voltage, so that multiplying the amperage by the voltage does not give the correct power in watts. For a three-phase current, amperage $\times$ volts $\times \sqrt{3}$ = kv.-a, called kilovolt-amperes. If this

[1]Bulletin of the School of Mines and Metallurgy, University of Missouri, August, 1915.

kv.-a. is multiplied by the power factor the result is the power in kilowatts (kw.). This can be represented by a triangle of which the kv.-a. is the hypotenuse and the kw. the long horizontal length, in which case kw. $\times$ cos $\angle$ = kv.-a. Whenever the kv.-a. or the kw. are specified, the power factor should always be given to obviate any chance of misapprehension.

Emergency Pipe Wrench*

While doing erection work a considerable distance from where tools could be obtained it was discovered that no pipe wrench large enough to handle a 2-in. pipe could be found on the job. The difficulty was overcome, however, as shown in the illustration. A solid wrench *A*, slightly larger in the jaw than the diameter of the pipe, was secured. The space between the pipe and the jaw was



A PIECE OF FILE FORMS THE GRIP

then filled by inserting a short piece of file *B*. The wrench was then operated in the direction of the arm, the file teeth taking hold as well as a pipe wrench, and the work was quickly completed.

Draftsman's Erasing Knife†

A rather clever and efficient little scratcher for the draftsman's use can be made from an old safety-razor blade and a 5- or 6-in. piece of 1/8-in. copper wire. The wire should be split longitudinally for about 1/8 in. by a jeweler's hacksaw, and a portion of the blade soldered into position in this slit, using a small blowpipe with a candle as source of heat, or a blue gas flame.

Any soft solder and its appropriate flux, as tin and muriatic acid, will work, but the most convenient solder and flux is "Solderall," which is a pure tin, finely ground, mixed with flux and put up in tubes ready for use. After soldering, the steel may be ground to any desired shape, giving a very thin, sharp edge, which will remove an inked line without cutting the paper or tracing cloth.

Incidentally it may be mentioned that "Solderall" is part of every chainman's equipment in the surveying district of Arizona, it being supplied by the surveyor-general, together with a number of sleeves just fitting the tape used. If a break occurs in the field, the men fit the broken ends into a sleeve, put "Solderall" at both ends of the sleeve and hold a match under it.

*G. H. Plaine in "American Machinist," Nov. 4, 1915.

†H. N Bradstreet, Phoenix, Ariz., "Engineering News," Oct. 21, 1915.

The Hoisting Rope Question*

The matter of governing the use of hoisting ropes is one of great importance, inasmuch as in most mines the lives of many men for several hours in each day depend on the reliability of the ropes used to hoist the cages. This is well recognized, and in general the greatest care is exercised in inspecting the ropes and maintaining them in good condition. It is furthermore true that inspection of a rope is relatively simple, that the precautions against accident are easy to take and, particularly, that a good wire rope gives ample warning of being unsafe.

Nevertheless, distressing accidents do occur from failure of ropes, and practice in the methods of caring for, inspecting and retiring hoisting ropes varies greatly. Standardization is highly desirable in regard to the methods of rope fastening, to the ratio between rope and sheave diameters, to safety factors and the method of determining them and to the basis on which a rope should be retired from service. However, there were not obtainable, in this country at least, sufficient accurate data on which regulations as specific as desirable might be based.

In order to obtain technical information as complete as possible on this question of hoisting ropes, the leading rope manufacturers of the country were consulted and finally a conference was had at which representatives of the several manufacturers met with the chairman of the committee and discussed the matter in detail. Some of the most perplexing points were then referred to a committee of the manufacturers for further consideration. The general discussion and the report of this committee have brought out facts that are of great interest and technical value aside from their bearing directly on the question of safety.

Safety Factor

In considering first the matter of safety factors, questions arise as to what safety factor to require, what stresses to include in the divisor in determining such factor, and how to ascertain the dividend, or ultimate strength of the rope. As regards ascertaining the ultimate strength of the rope, the committee is convinced that it is both safe and economical to rely on the tables furnished by manufacturers in their catalogs or elsewhere. Since the strength of the material in the wire and the method of assembling the wires into the rope both have a bearing on the rope's strength, it is plain that there is much opportunity for variation. Nevertheless the product turned out is remarkably uniform and reliable. Each individual rope is not tested, but tests are made on ropes of the several constructions and classes of material, and these are constantly checked. The tables in the catalogs perhaps rather understate than overstate the strength of a rope, but the error is slight, is on the right side so far as safety is concerned and is not of enough consequence to affect seriously the matter of costs.

The total stress in a hoisting rope is made up of several factors. The most important of these is the dead load of the vehicle, its contents and the rope itself. Added to this is the stress caused by starting and acceleration; this may be extremely high if the hoisting engineer is reckless, careless or ignorant; the practice of starting with a slack rope, sometimes followed where the hoist is under-powered for its work, may put extraordinary tension on the rope.

*Abstract from "Rules and Regulations for Metal Mines," by Ingalls, Douglas, Finlay, Channing and Hammond; Bulletin 75, United States Bureau of Mines.

Then there is the bending stress when the rope takes the curve of the sheaves, drum or reel or straightens out when leaving it. These three stresses are more or less calculable. Finally there are extraordinary stresses, such as those that occur when a shaft vehicle is pulled at full speed into a constriction of the shaft or when it is overwound. These of course may be of such magnitude that no rope could be expected to withstand them. It is also true that high-speed hoisting is harder on a rope than low-speed and causes more rapid deterioration—a consideration of importance in determining safety factors.

Permissible Hoisting-Rope Safety Factor Difficult to Figure

What stresses shall be considered in calculating the rope safety factor? While those due to acceleration and bending are determinable, they are not easily so, and it seemed to the committee that it was desirable to make the provisions of this code easy of analysis and enforcement. It was therefore decided to calculate the safety factor on the basis of dead load only and make it proportionately greater.

It is evident that with so many different elements affecting the service of a rope, no single safety factor could be selected that would be effective and fair for all cases. It was the sense of the majority of the manufacturers' representatives that the service of ropes should be classified, taking account of the depth of the shaft, whether it be vertical or inclined, wet or dry, whether the hoisting be fast or slow, whether the water be "acid" or not, etc., and that the safety factor and other requirements should be varied to suit these several classifications. Such a course would be theoretically correct, but would result in provisions too complicated for a code such as this. The code therefore imposes a minimum safety factor for all installations and another below which no rope shall fall and remain in service; very deep shafts it exempts altogether.

However, the manufacturers' committee, of which mention has been made, went carefully into some phases of this matter and compiled some tables that represent good practice and constitute excellent rules for mining operators to follow. In the first place, the safety factor is varied according to the depth of the shaft, one is specified for new ropes and another below which no rope shall be allowed to fall. The factor is to be determined by dividing the manufacturers' figures for breaking strength by the dead load.[1]

TABLE 1. HOISTING-ROPE SAFETY FACTORS FOR VARIOUS DEPTHS OF SHAFTS

Length of Rope, Feet	Minimum Safety Factor for New Rope	Minimum Safety Factor When Rope Must Be Discarded	Percentage Reduction
500 or less	8	6.4	20
500 to 1,000	7	5.8	17
1,000 to 2,000	6	5.0	16⅔
2,000 to 3,000	5	4.3	14
3,000 and over	4	3.6	10

The several factors given in Table 1 are based on an actual safety factor of four and are made greater for the shallower shafts because in them the acceleration stresses and a good many of the possible extraordinary stresses are normally greater. In deep shafts it is well recognized that the spring of the rope acts to eliminate the shock of starting and to decrease the stresses of acceleration.

Then for the several depths of shaft, or lengths of rope in the shaft, maximum permissible hoisting speeds are specified. These are given in Table 2.

TABLE 2. PERMISSIBLE HOISTING SPEEDS WHEN SPECIFIED SAFETY FACTORS ARE USED

Length of Rope in Shaft, Feet	Maximum Hoisting Speed, Ft. per Min.	Length of Rope in Shaft, Feet	Maximum Hoisting Speed, Ft. per Min.
500 or less	1,200	2,500 to 3,000	2,500
500 to 1,000	1,600	3,000 to 3,500	2,750
1,000 to 1,500	2,000	3,500 to 4,000	3,000
1,500 to 2,000	2,000	4,000 to 4,500	3,250
2,000 to 2,500	2,250	4,500 to 5,000	3,500

Permissible Acceleration of Hoisting Speed

Finally, a table of permissible accelerations is given for various hoisting speeds which are not to be exceeded with the safety factors specified. These are shown in Table 3.

TABLE 3. PERMISSIBLE RATES OF ACCELERATION FOR CERTAIN HOISTING SPEEDS AND SAFETY FACTORS

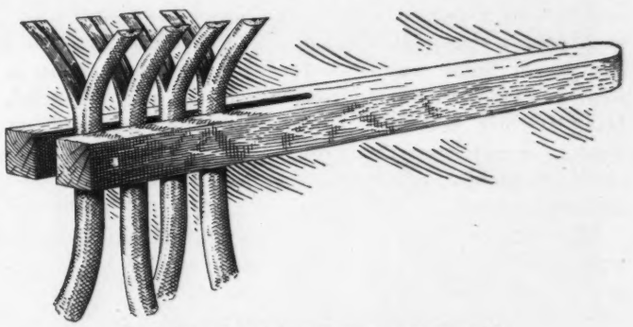
Speed, Ft. per Min.	Maximum Acceleration, Ft. per Sec.	Minimum Time of Acceleration in Which to Attain Speed Corresponding Thereto, Seconds	Speed, Ft. per Min.	Maximum Acceleration, Ft. per Sec.	Minimum Time of Acceleration in Which to Attain Speed Corresponding Thereto, Seconds
500 or less	4.16	2	2,000	8.33	4
750	4.16	3	2,500	8.33	5
1,000	5.55	3	3,000	8.33	6
1,250	5.95	3½	3,500	8.33	7
1,500	6.25	4			

Device to Aid in Fuse-Spitting

By Lowe Whiting*

The device illustrated herewith is used in some of the iron mines of Michigan as an aid in blasting.

It consists of a slotted stick, 6 or 8 in. long, whittled from a piece of powder box. The ends of the fuses are



DEVICE TO AID IN FUSE SPITTING

forced into the slot, then split in the usual manner, ignited, and the stick snatched away to be used again.

It is found to be a considerable help in wet places, where the miner holds the ends of the fuses close to his body, bending over to protect them from the dropping water.

A Wire Rope "Don't"

Do not allow a wire rope to be pulled around a tree, stump or column, as such treatment tends to cause the strands to untwist and to curl up like a watch spring.—*Leschen Bulletin.*

[1]The factor of safety of all such ropes or cables when newly installed in shafts less than 3,000 ft. deep shall in no case be less than six, and shall be calculated by dividing the breaking strength of the rope, as given in the manufacturers' published tables, by the sum of the maximum load to be hoisted, plus the total weight of the rope in the shaft when fully let out.

*Manager, Whiting Engineering Co., Iron River, Mich.

Details of Milling and Smelting

Oxyacetylene Welding at Braden

By Alma Ek* and J. R. Thill*

An acetylene generator of the portable type arrived at the Braden mechanical shops in December, 1913. The machine came to Chile without any instructions as to its operation. No one then at the plant understood much about acetylene generators, and the lack of necessary instructions caused a great deal of work, worry and a few narrow escapes from serious injury. However, it was soon operated in such a way as to be a great help in the cutting of plates and structural steel. This was considered good progress, taking into account the manner in which it had been attained.

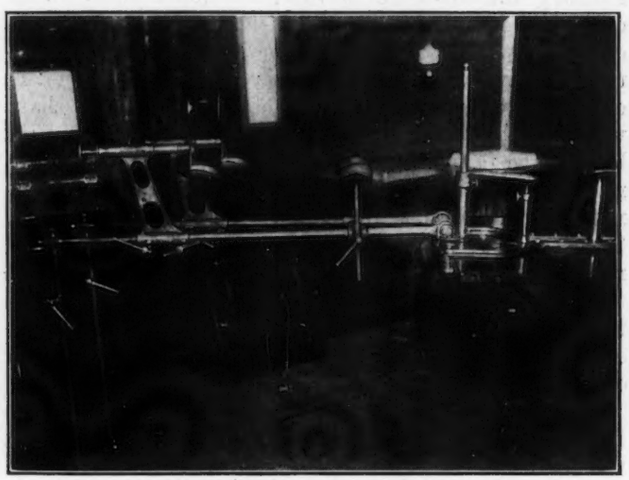
Welding was attempted under great difficulties, but was nevertheless tried because there was an enormous field for this class of work at the Braden plant. The first attempts at welding were made on blast-furnace water jackets. A number of these jackets were lying around, being perfectly good except for the last few inches near the top on the inside. Here the action of the acid in the wet concentrates charges ate away the metal until it finally gave out. To patch such a jacket in the shops with the previous equipment was costly, and at the same time a perfect job was almost impossible.

Having no one who understood the art of making a good weld, or even the proper flame to be used, it was necessary to do a lot of experimenting. The first attempts consisted of welding together two small pieces of steel plate and then breaking the weld by bending, and this naturally gave poor results. It was by this method, however, that the proper flame was discovered. After many trials a weld was made that was stronger than the original metal, being slightly heavier. An attempt was then made at welding a patch on the most worthless jacket at hand. Here the problem of expansion and contraction of metals was encountered.

The bad part of the jacket was first cut out, after which a plate was laid on top. The first three edges made a fairly successful weld, but the last seam continually cracked while cooling. After several experiments a jacket was welded successfully by first cutting away the worn portion and also including several inches of the flange and then taking a 3/8-in. boiler plate and welding first the seam across the face of the jacket. This was then heated with the torch and flanged into place, after which it was trimmed with the cutting torch and the other three seams welded. Since then all our jackets have been patched by cutting out the worn portion and flanging a plate, as shown in Fig. 1, and then welding by first doing the seam across the face of the jacket. Fig. 2 shows a number of blast-furnace jackets all welded, tested and ready for use. These have since been in service for almost one year and have stood up under such severe conditions that they may be pronounced an entire success.

*Master mechanic and assistant master mechanic, Braden Copper Co., Rancagua, Chile.

The first welding of cast iron was done under the most trying conditions. A nut fell from the safety air-discharge valve into the impellers of a No. 7 Roots rotary blower, cracking one impeller for a distance of 15 in. and the other for a distance of 9 in. This threw the faces out of line so badly that the machine was unable to run. This job was a difficult one. The impellers were first wedged so that they would come in line. They were then heated with a crude-oil torch to a dull red and welded, after which they were again thoroughly heated and allowed to cool slowly. The rough weld was then chipped and filed to a neat fit, and in 27 hr. from the time the blower was disabled it was again in first-class condition and has been running continuously ever since. Had this weld failed or been unsuccessful, the blower would have gone to the scrap heap. Since then many cast-iron welds



APPARATUS MADE FOR BRADEN HOSPITAL

This is used in connection with the X-ray machine in setting bones and dislocations of the lower extremities. It would have been very difficult to have made the apparatus in the Braden shops without the oxyacetylene flame.

have been made on hoisting-engine frames, large and small pulleys, cylinders, etc.

Figs. 3 and 4 show a broken motor frame. This motor is used on the blast-furnace charge cars. The bearing *A* was broken off completely, and *B* had two sections broken out. The most difficult part of this job was to keep the two bearings in line, owing to the position of the break, but by clamping a mandrel in the bearing *B* to hold the broken part *A* in position, little trouble was experienced.

After being successful with steel and cast-iron welding, we turned to copper, which offered many obstacles not previously encountered. The thermal conductivity of copper is high, therefore heat is much more rapidly dissipated than in either iron or steel. Copper also oxidizes rapidly. The oxide will dissolve in the molten metal, and unless the greatest care is exercised the mechanical properties will be changed materially. The molten metal will also dissolve gases from the welding flame, principally carbon monoxide and hydrogen. These gases will

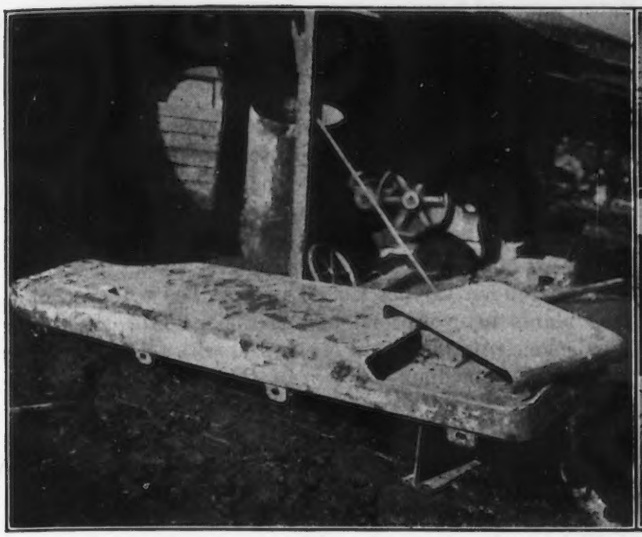


Fig. 1—Water jacket and patch ready to be applied

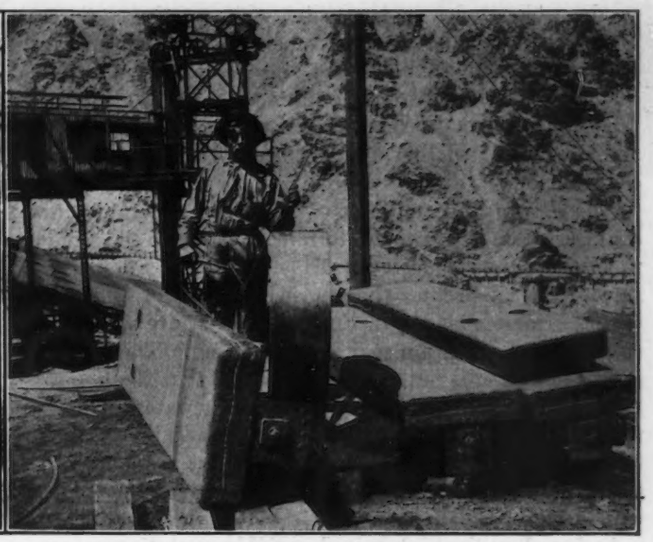


Fig. 2—Furnace jackets repaired by oxyacetylene welding

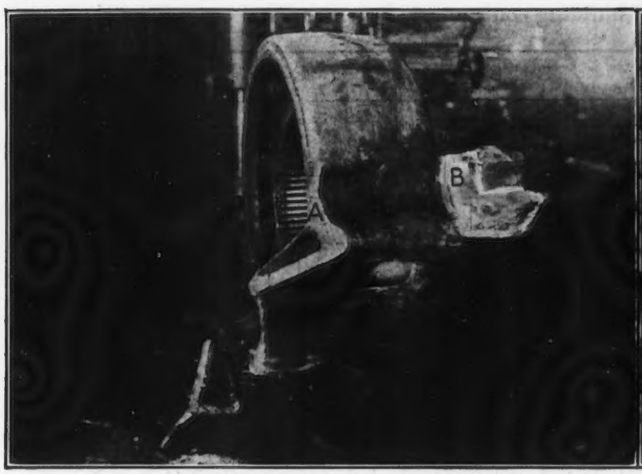


Fig. 3—Motor frame broken through bearings

Fig. 4—Motor frame restored by oxyacetylene welding

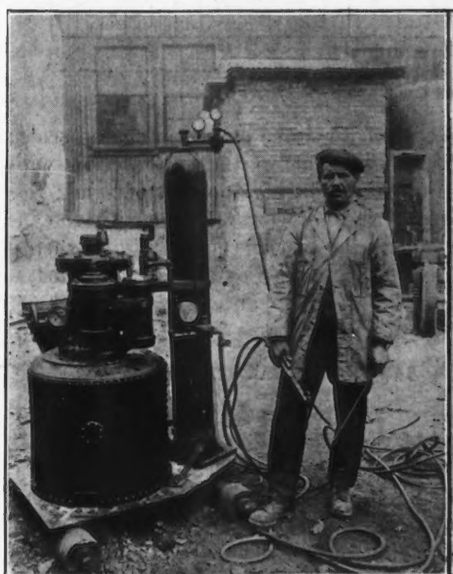


Fig. 5—First portable generating apparatus

Fig. 6—Present standard portable generator

Fig. 7—Small portable outfit

OXYACETYLENE WELDING AT THE BRADEN COPPER CO.'S WORKS IN CHILE

produce blow-holes in the metal while cooling. Several attempts were made that were unsuccessful, owing mainly to blow-holes in the weld, but since obtaining a suitable flux to offset this difficulty, a number of copper cylinders used for electric heaters have been successfully welded and it is expected that all the blast-furnace water-cooled copper spouts will be repaired as they become worn.

The design and building of acetylene generators that could be more easily taken to remote parts of the Braden works were then undertaken. The result was the machine shown in Fig. 5, later the one in Fig. 6, and finally the small portable machine in Fig. 7. As they are all successful, a brief description may be interesting. The machine shown in Fig. 5 is built on the principle that the fine carbide drops from the hopper above into the water. The gas thus generated passes through a felt strainer, then through the water safety chamber, then through the reducing valve and into the service hose. The machine is not fitted with all the so-called automatic safety devices that are to be found on the high-priced portable or stationary generators. A good operator is mainly depended upon for safety, and without a good operator no machine is safe. The machine is also equipped with a good safety valve, which has never been necessary because of a feeding device developed at this works. The feeding arrangement deserves special mention. It consists of a hinged gate with the operating rod passing through the carbide to the top of the hoppers, where it is connected to the arm of the operating lever, which is so counterbalanced that the gate is closed automatically. This gives a positive feed, as the operating rod passing through the carbide acts as an agitator and prevents the carbide from arching over the opening. Trouble is experienced frequently with the more expensive slide-valve arrangement, which operates so slowly that the carbide often bridges and refuses to drop; on being loosened by shaking or jarring the machine, the carbide drops so quickly that the valve cannot be closed in time to prevent a dangerous pressure developing. The locally developed device has proved so successful that the hoppers of two factory-made machines have been changed to this arrangement.

The machine shown in Fig. 6 is the same as that in Fig. 5, with the exception of being a little larger and with all joints oxyacetylene-welded. Fig. 7 shows an acetylene generator designed especially to produce gas enough to do small jobs of cutting or welding in some place where too much time or expense would be involved in transporting a larger machine. It can be disconnected at *A* and each half carried by a man up a ladder if necessary. It can then be set on a flat place, connected and filled with the necessary water and carbide. It is not claimed that this machine is foolproof, but it is safe when used by an intelligent operator.

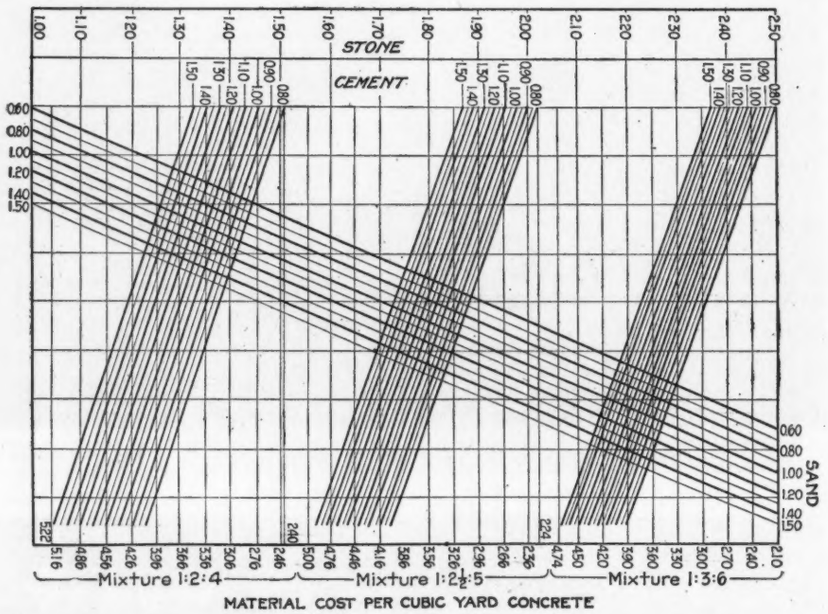
With the number of generators at hand the Braden company can now handle any piece of work that it pays to do by this method. It is found that not only can repair work be done more cheaply by this method, but also much new work, such as pipes, oil heaters, tanks and boilers. Joints can be made to stand a pressure of 100 lb. per sq.in. when required. This work is being done with a saving in both time and money.

The small engraving shows an apparatus that was made in the company shops for use in the Braden hospital, in connection with the X-ray machine, in setting bones or dislocated joints of the lower extremity of the body. It would have been a difficult piece of work for the Braden shops without the use of this process.

The Braden Copper Co. at present has three generating plants in operation—one in the machine shops, one at the smelting plant and one in the mill. There are also ready for immediate use two of the small portable generators.

Concrete Cost Computing Chart

A chart from which the cost of a cubic yard of concrete may be readily traced for different variations in mix and cost of material has been prepared by A. Pearson Hoover, contracting engineer with the John W. Ferguson Co., building contractors, Paterson, N. J., and New York City.



MATERIAL COST PER CUBIC YARD CONCRETE

Begin with the cost of the stone on the left-hand scale; read along the horizontal line to the intersection with the long oblique lines representing the cost of sand; follow this proper cost line to its intersection with the inclined lines representing the cost of cement; from whence read horizontally to the right and obtain the total material cost of the concrete per cubic yard.

Cyaniding Concentrates

The application of flotation concentration brings up again the question of the cyanidation of concentrates. It is well to remember that former practice applies with the one difference of oil elimination. Roasting the concentrates is one procedure, but it has the disadvantage of leaving an objectionable carbon deposit. An alternative is in washing the concentrates with a hot alkaline solution—in other words, saponifying the oil and washing it out. The method may be of value in some cases.

Company Reports

Oriental Consolidated, Chosen

The Oriental Consolidated Mining Co., Usan District, Chosen, reports a profit of $660,095 for the year ended June 30, 1915. The mines produced 297,889 tons of ore having a gross value of $1,951,588, or $6.54 per ton. The following table gives a summary of the operating record for the year:

Receipts:	Per Ton Ore
From bullion	$3.29
From concentrates	2.16
From store profit	.04
From interest and other receipts	.12
Total	$5.61
Expenditures:	
Mining costs	$1.91
Milling costs	.48
Concentrate expense	.21
Transportation of ore	.01
General expenses	.48
Total operating and general expenses	$3.09
Development of outside mines	.07
Construction expenses	.24
Total expenses	$3.40
Surplus for year	2.21
Total to balance with receipts	$5.61

Mining costs consisted of 83.273c. per ton for supplies, 0.608c. for assays, 1.347c. for shops, stables, etc., 12.689c. for salaries and board, 78.726c. for payrolls and 14.661c. for electric light and power. The principal items of mining supplies were: Cordwood, 10.471c. per ton; mining timber, 26.498c.; lumber, 8.968c.; charcoal, 1.401c.; dynamite, 0.884c.; detonators, 1.512c.; candles, 7.573c.; fuse, 3.132c.; oils and lubricants, 0.855c.; drill steel, 1.682c.; iron, steel and rails, 2.291c.; tools and hardware, 0.909c.; miscellaneous supplies, including pipe and fittings, pump parts, etc., 7.267c.; and electrical supplies, 0.830c. per ton of ore.

The report gives the following quantities of supplies used: Cordwood, 8,042 cords; mining timber, 125,664 pcs.; dynamite, 168,040 lb.; detonators, 921,719 pcs.; candles, 172,560 lb.; fuse, 180,625 ft.; kerosene, 460 gal.; cylinder oil, 1,105 gal.; engine oil, 2,915 gal.; lubricants, 3,101 lb.; drill steel, 59,302 lb.; iron bar, 21,194 lb.; iron sheet, 14,568 lb.; steel, 784 lb.; and nails, 29,725 lb.

The principal items making up the milling cost of 48.207c. per ton treated were: Supplies, 14.907c.; assays, 0.615c.; shops, etc., 2.567c.; electric power, 16.340c.; salaries and board, 7.27c.; and payroll, 6.508c. per ton.

The following supplies were used in milling operations in the quantities stated. Cordwood, 3,239 cords; battery shoes, 586 pcs.; battery dies, 438 pcs.; bosses, 26 pcs.; tappets, 18 pcs.; cams, 12 pcs.; stems, 24 pcs.; cam shafts, 19 pcs.; crusher shoes and dies, 2 each; iron bar, 9,984 lb.; iron sheet, 12,889 lb.; steel, 3,209 lb.; candles, 1,200 lb.; kerosene, 655 gal.; cylinder oil, 140 gal.; engine oil, 770 gal.; lubricants, 1,292 lb.; quicksilver, 30,554 oz.; and nails, 3,589 lb.

The assay office ran 36,898 assays at a cost of 12.75c. per assay.

The ore reserves of the various mines operated by this company are estimated to contain 844,000 tons having a gross value of $4,841,085. The Kuk San Dong reserves were exhausted, and the property has been closed down. The company ended the year with $463,410 in cash after paying dividends aggregating $858,780. Current debts amount to $52,189. The company's store carries about $266,688 of supplies on hand.

American Smelting and Refining Co.

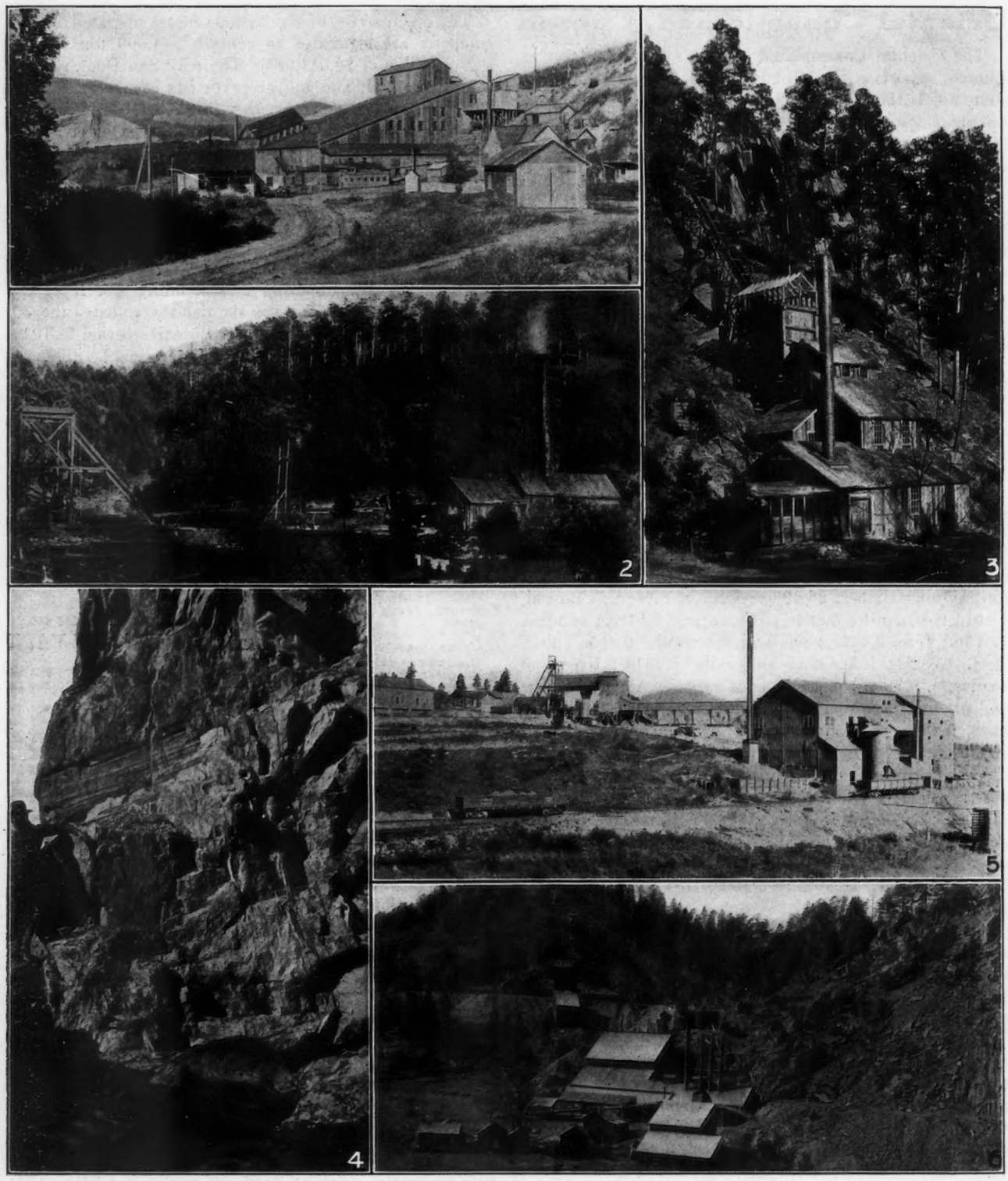
The American Smelting and Refining Co. reports a profit of $5,019,982 for the six months ended June 30, 1915, an increase of $53,290 over the same period in 1914. Dividends aggregating $3,004,900 were paid. The accompanying summary of income and profit and loss for the American Smelting and Refining Co. and the American Smelters Securities Co. gives a comparison for the first half of 1914 and 1915.

	Six Months Ended June 30, 1915	Six Months Ended June 30, 1914
Net earnings of smelting and refining plants and industries dependent thereon	$5,234,925.47	$5,462,094.17
Net earnings from mining properties	767,469.09	614,727.19
Total net earnings of operating properties	$6,002,394.56	$6,076,821.36
Other Income—Net:		
Interest, rents, dividends, commissions	754,958.68	705,432.78
Gross income	$6,757,353.24	$6,782,254.14
Charges Against Gross Income:		
Administration expenses	$449,105.75	$470,924.96
Research and examination expenses	23,492.23	30,390.31
Corporate taxes, including accrued income tax	71,480.03	74,328.83
Interest on debenture bonds	388,680.61	450,000.00
Amortization of discount on bonds	25,000.00	25,000.00
Depreciation	779,612.60	764,918.13
Total charges	$1,737,371.22	$1,815,562.23
Net income for six months	$5,019,982.02	$4,966,691.91

The company purchased and improved a zinc plant situated at Sand Springs, Okla. The total expenditures for property, additions, new construction and improvements was $860,272, of which $779,612 was charged off as depreciation. Cash on hand and in transit increased $11,114,600 during the period. Better conditions in Mexico are expected to help the company's showing in the near future.

The American Agricultural Chemical Co., New York, reports a net profit of $3,675,145 for the year ended June 30, 1915. Dividends amounting to $1,654,176 were paid on the preferred stock and $737,236 on the common stock. The profit stated was after charging off $890,393 for depreciation of plants and mines and $821,488 for freight, losses and contingencies. The report shows a total profit of $34,576,102 since the organization of the company, of which $24,799,401 has been paid out in dividends. Current assets total $35,359,732, of which $15,444,628 represents accounts and $8,795,492 bills receivable. Cash on hand aggregates $2,109,559. Current liabilities total $6,541,837, which includes $4,835,080 of notes payable. There are $9,428,000 of first mortgage 5% bonds and $7,500,000 of debenture 5% bonds outstanding. The sum of $157,408 was deducted from the year's profit to cover bad debts.

Photographs from the Field

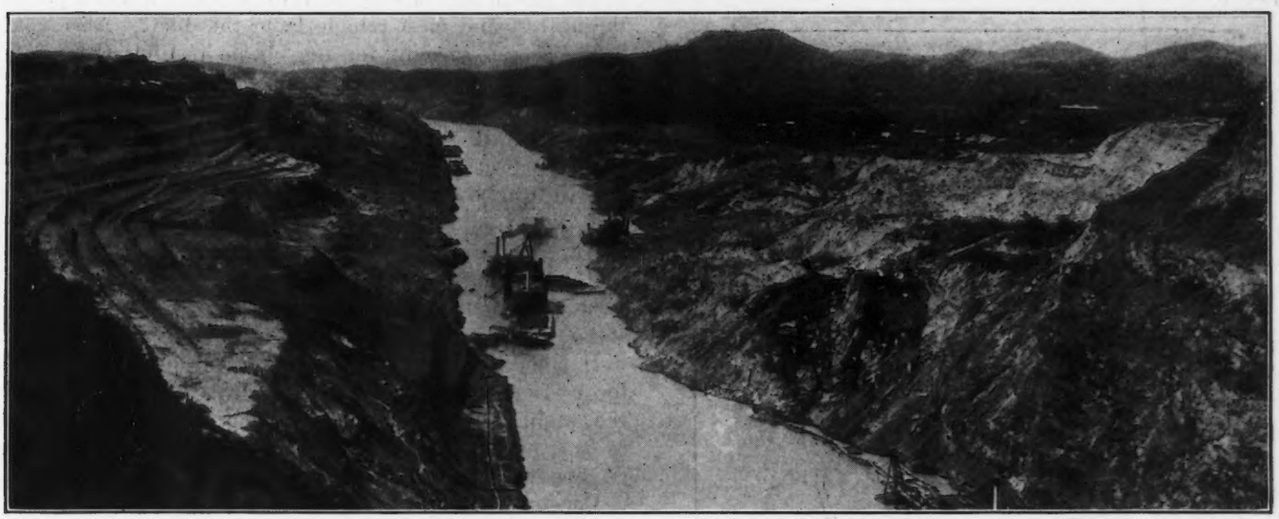


SOME VIEWS OF MINING IN THE BLACK HILLS GOLD DISTRICT, S. D.

1—The Golden Reward Con. Gold Mining and Milling Co.'s cyanide mill, 200 tons' capacity, at Deadwood. 2—The Columbia mine, at Keystone, where Superintendent Blackstone, of the Homestake, is sinking a 300-ft. shaft on a promising prospect. 3—Mizpah No. 1 stamp mill at Keystone. 4—Immense spodumene crystal at the Etta mine, near Keystone. 5—The Golden Reward Co.'s roaster at Astoria mine in Ruby basin. Here 75 tons daily of blue ore are roasted in a Wedge furnace, preparatory to cyanidation at the Deadwood mill. 6—The Keystone-Holy Terror mill, at Keystone

VIEW NORTH BETWEEN CONTRACTORS HILL (LEFT) AND GOLD HILL (RIGHT), SHOWING CULEBRA REGION OF THE PANAMA CANAL

Small slides on both banks caused by admission of water to canal. The great slides came later



THE CULEBRA SLIDE IN AN EARLY STAGE; SLIDE FROM EAST SIDE ONLY, OCTOBER, 1914

FULLY DEVELOPED CULEBRA SLIDE, AFTER AUGUST, 1915, WHEN BOTH BANKS SLID

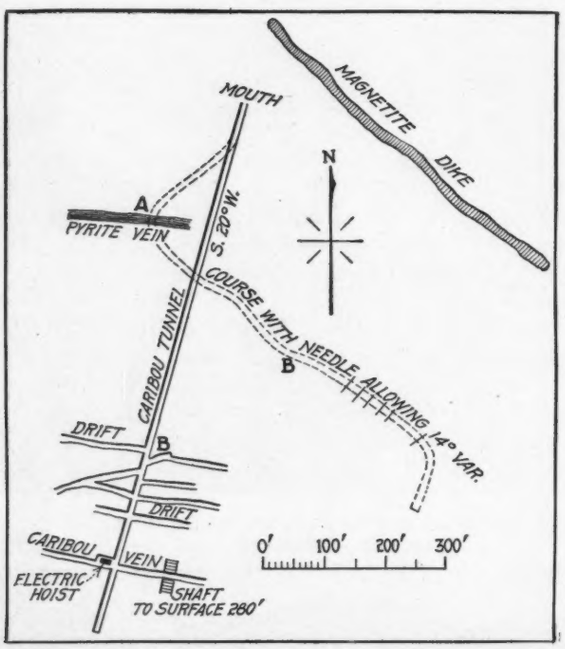
Correspondence and Discussion

Peculiar Magnetic Phenomenon

I wonder if any of the "Wise Men of the East" can explain the following uncanny magnetic freak. It has annoyed me much in not being able to solve it myself.

Last winter I had occasion to examine the old Caribou mine in Boulder County, Colorado, once a famous rich silver mine and now being opened up again by Henry P. Lowe. My attention was called by Norton H. Brown, superintendent of the mine, to certain magnetic disturbances. I hardly knew whether to take him seriously until I had verified every statement he made. The facts are as follows and were determined by me with a Brunton compass.

First: The Caribou crosscut tunnel is 900 ft. long, true course S20W. It cuts six veins all within a space of 200 ft., on which drifts are driven. Allowing the proper Colorado variation of 14° E and taking bearings



MAGNETIC COURSE IN CARIBOU TUNNEL

every 50 ft. in the tunnel gives the remarkably crooked course shown on the map by dotted lines, the two ends of the tunnel registering the right course, but all out of joint in between.

Second: At any of the drift and tunnel intersections, the needle reading of the tunnel is about S50°E, as per sketch, but if one goes 10 ft. or so into any of the 10 drifts, the needle reads all right, and one would think the "Tommyknockers" had possession of the mine when, holding a compass in one's hand in the tunnel, with the needle pulled around 70° from its proper course, one can back off into any of the drifts and watch the needle gradually swing around 70° to its proper North-Pole habits.

Third: Walking over the tunnel line on the surface, which rises 20°, and taking needle readings every 50 ft., as in tunnel, shows no such freakiness, but a uniform needle disturbance of 10° or S10°W in place of S20°W. The only observable geological condition that might affect the needle is the existence of a strong magnetite dike 10 ft. wide, standing vertical and running S50°E, which, strange to say, is identical with the tunnel readings for 600 ft. of its length and may give a clue to the mystery. At *A*, where tunnel readings change 90° from NE to SE, there is nothing but a small iron-pyrite vein crossing at right angles. It has no magnetic qualities, but I have thought possibly to one side of the tunnel it might change to magnetite and account for the unusual disturbance at that point.

One would naturally attribute the whole matter to the magnetite dike, but why does the needle read true at the mouth and face of the tunnel, which are two points the nearest and most remote from the dike? Also what influence can account for the needle reading O.K. only 10 ft. away from tunnel in any of the drifts? Why does a set of readings over the tunnel line at surface not agree with those taken in tunnel? Can the bore of the tunnel itself be magnetic? If so, why does it not act uniformly and who ever before heard of a tunnel hole acting as a magnet? Insulated wires of 250 voltage extend from *B* to the hoist, and I was working up a theory along that line until Mr. Brown told me the same conditions prevailed before the power line was installed. The rock formation is granite and schist.

If I had not observed this myself, I should be inclined to question if the author had not been out to a banquet the night before. The tunnel, however, is still there to back me up, and the Brunton compass will ordinarily do fine work, but it is sure locoed in Caribou tunnel.

Denver, Colo., Dec. 2, 1915. EDWIN E. CHASE.

NEW PATENTS

United States patent specifications listed below may be obtained from "The Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c .each.

AIR-HOSE COUPLING. William Engle, Taylor, Wash. (U. S. No. 1,161,641; Nov. 23, 1915.)

ALKALI HYDROXIDES—Process for the Simultaneous Production of Soluble Alkali Hydroxides and Cement-Making Material. Arthur William Heyman, Northampton Borough, Penn. (U. S. Nos. 1,160,171 and 1,160,172; Nov. 16. 1915.)

ALUMINA — Crystalline Fused Alumina and Method of Making the Same. Leonard B. Coulter, Niagara Falls, N. Y., assignor to The Carborundum Co., Niagara Falls, N. Y. (U. S. No. 1,161,620; Nov. 23, 1915.)

ALUMINUM—Process for Producing Aluminum from Clay, Kaolin, and Other Aluminum Silicates. Grenville Mellen, East Orange, N. J., assignor of one-half to United Aluminum Ingot Co. (U. S. No. 1,160,431; Nov. 16, 1915.)

ALUMINUM—Process of Melting Aluminum or Aluminum Alloys. Grenville Mellen, Mount Vernon, N. Y. (U. S. No. 1,160,430; Nov. 16, 1915.)

ALUMINUM—Solder. Joseph Cayocca, Sacramento, Calif. (U. S. No. 1,161,612; Nov. 23, 1915.)

AMALGAMATING MILL — Abrasive Amalgamating Mill. James B. Shackey, San Francisco, Calif. (U. S. No. 1,161,418; Nov. 23, 1915.)

The Juneau Gold Lode

F. W. Bradley, president of the Alaska-Juneau Gold Mining Co., in the application for the listing of the shares of that company on the New York Stock Exchange, gave the following succinct description of the Juneau gold lode:

The vein consists of slate carrying gold-bearing quartz irregularly distributed through it in the form of veinlets, stringers and masses. Dikes of metagabbro have intruded themselves into the vein, and these dikes in turn carry quartz similarly distributed. In some places the quartz is sparingly distributed, while in others it is more or less concentrated. It seems highly probable that this quartz can, to a considerable degree, be sorted from the inclosing vein matter, thus yielding a materially higher mill feed than the average of the mass.

From 1896 to 1914 a 30-stamp mill was operated upon the Alaska-Juneau property with the result that 295,807 tons of ore were milled, yielding $669,589.31, or at the rate of $2.26 free gold per ton. This yield was obtained by milling about 63% and rejecting about 37% of the ore mined. If the whole 472,783 tons had been milled, the free-gold recovery would have been about $1.50 per ton, as the rejected vein matter is also gold-bearing. No attempt was made to save the values in the sulphides which, if saved, would have added about 20c. per ton. A tailing loss of an equal amount is definitely known, so that the total value per ton would approximate $2. All of the ore was from selected surface workings scattered over the best known portions of the vein.

The main working tunnel, known as the Gold Creek tunnel, at an elevation of 425 ft. above sea level, has been driven since the aforementioned surface mining and milling work, and at a point 6,450 ft. from the portal an incline raise has been put through to the surface. In driving the Gold Creek tunnel, a portion of the vein on the west side of what is known as the Silver Bow fault was crosscut diagonally for a distance of 650 ft., disclosing bodies of ore the assay values of which average slightly less than $2 per ton. The ore extracted from both the Gold Creek tunnel and the intermediate level opened from the incline raise at an elevation of 495 ft. above the Gold Creek tunnel has been milled in the new mill erected on Gastineau Channel. Because of the mixture of waste with the ore, due to opening up these two levels preparatory to stoping, the mill-feed assay value of 50,000 tons milled up to Dec. 1, 1914, averaged $1.36 per ton.

The cubic contents of the vein above the Gold Creek tunnel level and between the eastern and western ends of the Alaska-Juneau property, totals approximately 500,000,000 tons of slate, metagabbro and quartz. From this there should be mined, from selected places, 80,000,000 to 100,000,000 tons of vein matter and quartz suitable for milling that should yield a net profit of from 70c. to $1 per ton, depending upon conditions of mining that cannot at this time be estimated within closer limits of ultimate profit. Areas will probably be found in which mining may profitably be conducted by sorting, leaving two tons in the stopes for every ton milled. Other areas will probably be found, all of which may be mined without the necessity of mine sorting, but on this there is nothing definite known

The mining chances below the Gold Creek tunnel level promise an addition of twice as much tonnage of the same value as it is believed the vein will yield above the tunnel. These mining chances are based upon the fact that in a parallel vein two miles away, on Douglas Island, the orebodies are now being mined at a depth of 2,000 ft. below sea level. At that depth the Douglas Island orebodies still hold their size and average values.

First Steel Billets Made in Lake Superior District

DULUTH CORRESPONDENCE

On Wednesday, Nov. 24, the fires were lighted under one of the 500-ton blast furnaces of the Minnesota Steel Co., at Duluth, and the following day, Thanksgiving, the first steel billets ever manufactured in the Lake Superior district, where iron ore has been mined for about 65 years, were turned out. The other blast furnace will be ready to go into blast within a few days. Seven of the 10 open-hearth furnaces have been finished, and several of them are now in use. It will not be many weeks before all of the 10 will be ready.

There was quite a gathering of officials of the company and prominent men of the district in attendance when the first steel was turned out. The starting of this big plant marks an important epoch for the region where iron ore has been king for so many years and where steel has never been manufactured before. There are a number of blast furnaces manufacturing charcoal pig iron, but this is the first time that high furnaces, utilizing coke for fuel, have been tried. The steel billets will be shipped East to the United States Steel Corporation, the parent company. The rail mill and other mills will not be ready for some time, probably next spring, when another great step will have been taken in the steel business in the Northwest.

Most of the iron ore that has been delivered at the plant has come from the underground mines of the Oliver Iron Mining Co. in the Chisholm district, and steady shipments are now being made. The storage yards for fuel, limestone and ore are extensive, but it will not be necessary to load up in the fall with ore, as must be done in the East, as there is plenty of the raw material close by that can be hauled to the works at any time.

When fully completed, the Duluth plant will represent an expenditure of about $25,000,000. Employment will be given to a large force of men, and Duluth will be greatly benefited by having such a plant at its door.

Australian Gold Production

The gold production of the several states of the Australian Commonwealth for the eight months ended Aug. 31 is reported as follows, in fine ounces, South Australia being estimated:

	1914	1915	Changes
Western Australia	813,221	804,256	D. 8,965
Victoria	285,069	215,763	D. 69,306
Queensland	157,280	171,467	I. 14,187
New South Wales	82,852	90,833	I. 7,981
Tasmania	17,500	11,360	D. 6,140
South Australia	4,000	4,000	.....
Total	1,359,922	1,297,679	D. 62,243
Total value	$28,109,588	$26,823,025	D. $1,286,563

The small increases in Queensland and New South Wales were not sufficient to counterbalance the losses in the other states. Victoria showed the largest decrease,

while that in Western Australia was comparatively small. The general result shows a decrease of 4.6% in production and points to an approximate total of $40,000,000 as the contribution of Australia to the gold supply of the world in 1915. New Zealand has not made public the usual monthly statements of production this year. So far as can be estimated, it will show a decrease at a rate equal to, if not a little greater than, that of the Australian Commonwealth.

Willow Creek Gold District*

The Willow Creek gold district lies in south central Alaska, 10 mi. north of the head of Knik Arm, the farthest inland projection of Cook Inlet and the northernmost extension of Pacific Ocean waters in Alaska. This district is an area of rather indefinite boundary, lying in the southwestern part of the Talkeetna Mountains, and has gradually come to include not only the basin of Willow Creek, but all the mountainous portion of the little Susitna River basin.

The district lies along the contact zone of a great series of granodiorite intrusives that form much of the Talkeetna Mountains. As has been repeatedly pointed out, a large part of the gold deposits of Alaska occur in such contact zones. This is the condition in southeastern Alaska and in the Fairbanks, Chandlar, Iditarod and other inland districts. The geology of the Willow Creek district is therefore favorable to the occurrence of gold deposits. Were it not for the intense glaciation of this field, it would probably yield rich placers. As it is, the preglacial gravels that are most likely to contain the gold of placers have been swept away by glacial ice. The placers now found are chiefly post-glacial concentration, which are not likely to be so rich as the older gravels. In the absence of such rich placers and under the primitive conditions of transportation that existed until recently, there has been little to attract the prospector, and hence the region has not been so carefully examined for mineral deposits as its geological features would justify.

Though the Willow Creek district is the only part of the Talkeetna region in which commercial gold deposits have been found, other positive evidence of mineralization has not been lacking. Thus many of the northern tributaries of Matanuska River that cross the granodiorite contact carry some gold in their gravels, and the same is true of some of the eastern tributaries of the Susitna. All this evidence, together with what is known of the bedrock geology, makes it probable that other gold-bearing districts will be found in this province. In any event, the region in which the granodiorite intrusives occur is well worth prospecting.

The veins of the Willow Creek district occur in well-defined fissures, and there is no reason why they should not extend to considerable depth. Surface alteration is limited to a few feet, so that the present shallow workings can be regarded as evidence of the character of ore that deeper mining may reveal. The outlook for a permanent district is therefore hopeful.

Mining costs are now high, owing to the isolation of the district and the high price of fuel. The district, however, lies close to the line of the government railroad from Seward to Fairbanks, on which construction has now begun. Moreover, this railroad is also projected into the Matanuska coal field. When this project is completed, the district will be assured of an adequate transportation service and fuel at reasonable cost. Under these conditions, larger mining operations will undoubtedly be undertaken.

*From Bulletin 607, "The Willow Creek District, Alaska," by the United States Geological Survey, 1915.

Searles Lake Potash in 1916

At the recent annual meeting of the Consolidated Gold Fields of South Africa in London, Lord Harris in reviewing the company's American investments said:

> Of course the interesting question there is, What is the American Trona Corporation going to do? We experimented first of all with a process which proved after a fair trial to be unsuccessful, or, rather, too expensive and wasteful for adoption, and we have now reason to believe that the process which has been substituted will be entirely successful, besides being more economical. It is not a difficult process and has only to be adapted to the special climatic conditions of the country. A very elaborate trial of the brine was carried out during the summer by an independent firm of chemists, and the results have been reported on by capable referees so encouragingly that the company felt justified in ordering the plant, which, I am happy to say, is of a standard type, and at present it is anticipated that potash will be produced next year—the most optimistic hope in the earlier months—when we shall most probably still have the advantage of the high price obtainable for potash at the present moment. All the work necessary to secure the company's title to the area located in accordance with the mining laws of California is being carried out, with a view to obtaining an indefeasible title from the United States authorities. These proceedings necessarily take time, but our legal advisers inform us that they have no doubt that such title will be granted us in due course.

The process developed by Charles P. Grimwood has been adopted for the recovery of the salts from the Searles Lake brine. For reasons of economy of operation and better shipping facilities for the refined products, it has been decided to produce at Trona (Searles Lake) only mixed salts from the first part of the process and to refine these mixed salts at the port of San Pedro, Calif., where a site has been leased from the Southern Pacific Co. Construction is now under way both at Trona and at San Pedro. The initial units are expected to produce daily 100 tons of potash and 30 tons of borax. No other salts will be produced at first. Pending the completion of the refinery at San Pedro, a crude potash-borax salt may be marketed.

Humphreys & Miller, employed in connection with the adoption of the Grimwood process, state that there should be a recovery of at least 85% of the potash and 60% of the borax. Production costs at tidewater are estimated at $19 per ton for the first few months, at $12.87 per ton when the triple-effect evaporators are working and at $8 per ton with an enlarged plant. With a freight charge to the Atlantic seaboard (via the Panama Canal) of $7@8 per ton, this would make a cost of approximately $20 per ton with the first plant and $16 per ton for an enlarged plant having a daily capacity of 400 tons of potash and 120 tons of borax.

The Trona Ry. has been in operation since October, 1914, and early in 1915 the construction of a pumping plant and 10-in. brine pipe line from the center of Searles Lake to the site of the Trona plant was begun. Additional supplies of fresh water, for the village of Trona and the operation of the plant, have been obtained from the mountains north of Trona and right-of-way secured from the Government for pipe lines over lands withdrawn from entry.

Editorials

Blast-Furnace Capacity

The estimated production of pig iron in the United States in the month of October was 3,159,500 long tons, the largest quantity ever reported in a single month. The number of furnaces in blast indicates that the November make of iron will be quite as large as the October. The production at present is at the rate of nearly 38,000,000 tons a year, or 7,000,000 tons more than was made in 1913, the year of greatest output. That is, the blast furnaces of the country are running rather close to what is practically their maximum capacity. The statistics of the American Iron and Steel Association show that at the opening of the present year there were 451 blast furnaces, with a total yearly capacity of 44,405,000 tons. To this must be added five furnaces, then under construction but now completed, which raise the total number to 456, with a capacity to make 45,265,000 tons a year. At the present time, therefore, there is about 85% of the blast-furnace capacity active, and it is hardly to be expected that this proportion can be exceeded.

It must be remembered that a blast furnace cannot run forever without repairs; and at least 10% of the existing stacks must be out of blast at a time for relining and rebuilding, no matter how great the demand for iron may be. The list of existing furnaces has been rather strictly revised in the last two or three years, and a number of old stacks have been abandoned and dismantled. There still remain some that, on account of antiquated construction and equipment or unsuitable location, cannot work at a profit unless the demand is great and prices high. If we take these into account, 85% of the rated capacity comes very near to full employment. Moreover, a furnace will not run up to its full rating every day in the year, and its production will not be 365 times the daily rated capacity, even if under favorable conditions it may be speeded up to an excess for a few days. With a nominal yearly capacity of 45,000,000 tons, a yearly production of something under 40,000,000 is the greatest that can be attained.

The year 1915, however, will not approach that total. Early in the year demand was at a low ebb, and the officially reported make for the first half of the year was only 12,233,791 tons. Since June the production has been gradually climbing until it has reached its present high point. The first rush came in the make of the steel companies' stacks, and almost up to the present time we have heard complaints from the merchant furnaces. These have gradually disappeared, however, as more and more have gone into blast and steel interests have been obliged to go into the market for pig iron to supplement the make of their own furnaces. The first demand in the market, and the strongest at the present time, is for steel in various finished forms, though foundry work is gradually catching up with the rush.

We hear from all quarters just now, as in most boom periods, of additions and improvements at various steel works to enable them to keep up with the demand. Much work of this kind is under way or projected. Not much is heard, however, of new furnaces or of increasing pig-iron capacity. Iron men apparently believe that the present blast furnaces will be able to furnish all the iron that may be needed in the next year or two and are not yet ready to undertake additional construction of blast furnaces. It must be remembered also that the building of a new blast furnace on modern lines is a slow and expensive work, much more so than an addition to a steel plant, necessary as the blast furnace may be.

The Alaska Gold Mines

The slump in the shares of the Alaska Gold Mines Co., which, through the Alaska-Gastineau Mining Co., operates the Perseverance mine, near Juneau, Alaska, has excited a good deal of apprehension among the stockholders, who are widely scattered throughout New England and the eastern part of this country, the Alaska Gold Mines Co. being the latest promotion of Hayden, Stone & Co. The previous promotions of that house—Nevada Consolidated, Utah Copper Co., Ray, Chino and Butte & Superior—have been phenomenally successful, without exception. The Alaska Gold Mines Co. is just entering upon the first stage of its fruition.

This company owns a portion of a great lode of gold-bearing ore known to be of low grade, but believed to be capable of yielding an enormous profit in the aggregate when exploited by modern methods on a huge scale. The company reckoned on obtaining a net yield of $1.50 per ton at a cost of 75c. per ton. In the last annual report of the company, D. C. Jackling, the managing director, estimated a minimum of fully developed, partially developed and probable ore at not less than "75,000,000 to 100,000,000 tons having a recoverable value of $1.50 per ton, and the ultimate production of this grade of ore from the entire property will unquestionably be far in excess of these figures." Four mill units designed to treat 6,000 tons per day were planned for the initial equipment, the ultimate that was in view being 20,000 tons per day, but the first four units, which are now nearly completed (and have been partly in operation for several months) have been found to be capable of treating 10,000 tons per day instead of 6,000, and it is thought that their capacity may be raised to 12,000.

Previous to the putting of this mill into operation, the greatest skepticism among engineers pertained to the claims of Mr. Jackling and his associates that they were going to be able to mine and mill gold ore in any way for so small a sum as 75c. per ton. Nothing like that had ever been attained in the Treadwell group of mines opened on a parallel lode on the other side of the Gastineau Channel. Mr. Bradley and his associates operating the Treadwell group were among the skeptics, but they became converted and undertook the development of the Alaska-Juneau property, which adjoined the Perseverance. Mr. Jackling has already showed that he can mine and mill for about 60c. per ton, beating his orig-

inal estimate by a handsome margin and thereby earning a new triumph for himself.

The recent slump in the shares of the Alaska Gold Mines Co. began with rumors that the ore was not turning out so high in grade as was expected. Mr. Jackling in an interview stated that an unexpected occurrence of low-grade "schist" (slate) had been encountered in a part of the mine from which it was hoped to draw a higher grade of ore, and this material having to be put through the mill had reduced the general average. Up to the end of October the new mill had treated about 900,000 tons of ore, assaying about $1.25 per ton instead of the $1.75 expected. The cost of mining and milling, however, had been 15c. a ton lower and the loss in tailings about 5c. a ton lower than estimated, wherefore the net return was only 30c. per ton below the estimate for the average ore.

The Juneau gold lode consists of slate carrying gold-bearing quartz irregularly distributed through it in the form of veinlets, stringers and masses. Dikes of meta-gabbro have intruded themselves into the lode, which dikes in turn carry quartz similarly distributed. In some places the quartz is sparingly distributed, while in others it is more or less concentrated. The nature of the occurrence of the gold-bearing quartz in this lode implies irregularities in returns, portion by portion or month by month. These irregularities have always been recognized by the managements of both the companies developing the great lode. When the lode is so opened that ore can be drawn from a great many places, which is not yet the case, such irregularities will tend to be equalized in a true general average. It is premature to jump at the conclusion that the Juneau ore is not going to yield so much per ton as was expected.

As to the value of the shares of the Alaska Gold Mines Co., opinions will continue to differ until it has been demonstrated by the milling of millions of tons of ore just about what the average yield and average cost are going to be, after which these shares, being based upon gold, which is not so much subject to market vicissitudes as copper, zinc, etc., will probably become as steady as such well-seasoned gold-mining shares as Alaska-Treadwell, Homestake and others of that class. In figuring an amortized value it is necessary to take into consideration the life of the mine. A mine with a delimited ore-body figured upon as lasting 20 years ought to pay about 9½% gross in order to afford 6% net. As the expected life rises above 20 years the necessary annual amortization diminishes rapidly. When it is a matter of 50 years' life, a gross of less than 6½% is needed to yield 6% net, which is about the basis on which our great mines sell, whether they ought to or not.

The elements for a close valuation of Alaska Gold Mines shares are not yet available. If the company possesses 100,000,000 tons of ore yielding 75c. per ton, there is $75,000,000 net to be had; if only 40c. per ton, $40,000,000. If the extraction be at the rate of 3,000,000 tons per annum, there would be 33⅓ years' life; if at the rate of 6,000,000 tons per annum, only half as much. In general, the more rapidly the ore is extracted from a mine the more profit there is, and this is especially true of a gold mine. In the case of the Perseverance mine its owners expect to get a good deal more than 100,000,000 tons of ore.

The Advance in Silver

The price of silver has been remarkably even since the drop of about 3d. per ounce in the London market, which followed the outbreak of war last year. From October, 1914, up to October of the present year the variation in the monthly averages has not exceeded 1d. per ounce. The demand for silver from the East has been lighter than usual throughout this year, the shipments to India—usually a ruling factor in the market—having been less than in 1914 by 25%, while China has not only taken practically nothing from Europe, but for part of the time has sold rather freely from its own stock. On the other hand, there has not been an excessive supply, and sellers have not pressed the metal for sale, accommodating themselves to the conditions of the market. Silver production in the United States has been about the same as last year and in Canada, rather less; while in Mexico there has been a considerable decrease. The market has also been from time to time supported by buying for the United States Mint.

Since the close of October, however, there has been a steady advance, and the price, which stood at about 24d. in London on Nov. 1, has advanced to 26¼d., showing the greatest variation since the drop at the beginning of the war. This advance seems to be firmly held, and there are indications that it may go still farther.

As usual, several causes seem to be contributing to the rise. The demand from India has been better, and there is reason to believe that Chinese stocks are low and that there will be little selling from that country for a time, and perhaps some buying. The most direct cause is found in large purchases for the British, French and Russian mints. War conditions have brought about an unusual demand for silver coins, and the mints of the several countries are busy supplying them. It seems probable that the coinage demand will continue for some time. An increase in the Indian shipments is also confidently looked for.

Direct shipments to the East from this country have shown a considerable increase this year, the total exports from San Francisco to the end of October having been 11,250,000 oz., or about 1,200,000 oz. more than last year. The total this year was about one-sixth of the exports from London, but this is a larger proportion than usual and may indicate a growing disposition to take from San Francisco rather than London. The supremacy of London in the silver market, however, is so firmly rooted in the conservative East that it will be difficult to bring about a change.

The demand for silver coinage produced by the war is something that has heretofore been overlooked, attention having been concentrated on the huge demands for steel, copper, zinc, lead, etc., but nevertheless it has been real. The millions of men in the field are probably not rich in spending money, but they have some, which in the aggregate is considerable, and they live under conditions that result in the utter loss of a good deal of it. The recent requirements for silver appear to be, partly at least, to replace such loss. Whatever be the causes for it, the rise in the price for silver is a very satisfactory event for the producers at Cobalt, who have been carrying large stocks in their vaults for a long time, while more activity in prospecting is reported from there than for years past.

BY THE WAY

According to the *Peking Daily News,* Hunan Province is full of minerals, among which are antimony deposits in the central portion, pewter deposits in the southern, and copper, lead and coal in the southwestern. Since the Kiang Wha pewter mine is later mentioned specifically, we judge that the makers of fake antiques had better get hold of this mine and turn out pewter plates while you wait.

The following excerpt from a letter by a late resident of Morenci, now of Duncan, Ariz., needs no comment: "I have been driven from my home by the strikers. The sheriff and governor are hand in hand with them, and not only refuse to protect anyone in sympathy with the company, but go so far as to tell such people to get out of town. It is the worst state of affairs in this country when American citizens paying taxes for protection to their lives and property are not even allowed to live peacefully in their own homes."

A correspondent in Clifton, Ariz., sends us the following under date of Nov. 26: "The strikers are prepared to hold out indefinitely. The American Federation of Labor has passed resolutions indorsing the strike, and the Miami miners' union will continue to solicit its pay-daily subscription. Several women's organizations have the subject on the anvil, and the Globe and Miami teams will play a game of football for the strikers' benefit. Since the failure of the Greenlee supervisors to authorize 300 additional deputies and in the absence of any other payroll, the business of seeing that the company doesn't blow up its own property, etc., is so rotated among the union boys as to do the greatest good to the greatest number. One serves as deputy a while and then another. W. J. Donahue, of the Duncan tent colony, head supply man for the Detroit company, spent Saturday night, Nov. 20, in Morenci and was fired on through window of his own home. The bullet sunk harmlessly in the wall, however, and Donahue fired back. It is the consensus of opinion that Donahue and an accomplice was merely taking a friendly shot at each other. Summing up the strike situation, the score is 0 and 0, union at the bat, Davies and Myers umpiring. It is thought that directly after the federal investigation is concluded, most of the shift bosses, superintendents and managers will be spent to the penitentiary."

The scenes of the McCune-Marañon River Placers controversy have been shifted to Peru. Mr. McCune, who formerly controlled the property and later was made general manager, arrived in Peru about a month ago and in an interview in the *West Coast Leader* gives a different version of the fraud proceedings instituted in Wilmington, Del., last summer. Mr. McCune claims to have notified the directors on Feb. 8, 1915, of the failure to find bedrock and advised the abandonment of the enterprise; the directors, desiring to shift the responsibility for the fiasco upon someone else, decided to make him the "goat." Instead of an average of 80.9c. per cu.yd. and the belief that the bedrock gravel would run from $4 to $5 in gold per yd., as stated in the prospectus, subsequent drilling showed a layer of low-grade or worthless "gravel for about 20 ft. and an understratum of mud which at 100 ft. in depth showed no indication of bedrock, where it was originally believed the bonanza deposits would be found." Preceding Mr. McCune's arrival in Peru, George P. P. Bonnell, former treasurer and secretary of the company, landed at Collao in company "with an engineer by the name of Lohman and a United States postal inspector by the name of Barber." They left for the Marañon and, it is supposed, are searching for evidence. The *Leader* adds that "Mr. McCune, who has come to Peru to look after his interests in the case, is also accompanied by an engineer, and leaves for the *sierra* on Friday."

November Mining Dividends

Dividends disbursed in November, 1915, by 27 United States mining companies making public reports amount to $6,032,264, as compared with $1,437,123 in November, 1914. Industrial and holding companies allied to mining paid $11,196,293, as compared with $8,692,022 a year ago. Canadian and Mexican companies paid $1,057,607, as compared with $634,894 in November, 1914. The report of the Anaconda dividend in the *Journal* of Nov. 6, as being in October, was an error. The stock merely went ex-dividend at that time, while payment was made in November.

The totals for the first 11 months of the year are as follows: Mining companies, $61,012,688, as against $50,715,223 in 1914; metallurgical and holding companies, $76,638,095, as against $78,819,124 in 1914; Canadian and Mexican mines, $8,499,315, as against $14,315,259 last year.

United States Mining Companies	Situation	Per Share	Total
Ahmeek, c	Mich.	$2.50	$125,000
Alaska Mexican, g	Alas.	.10	18,000
Alaska Treadwell, g	Alas.	.50	100,000
Alaska United, g	Alas.	.30	54,060
Anaconda, c	Mont.	1.00	2,331,250
Bunker Hill Con., g	Calif.	.02½	5,000
Bunker Hill & Sullivan, l.s	Idaho	.25	81,750
Camp Bird, g	Colo.	.24	267,312
Chief Con., s.g.l	Utah	.05	43,838
Champion, c	Mich.	2.00	200,000
Golden Cycle, g	Colo.	.02	30,000
Gold King, g	Colo.	.01	10,000
Hecla, l.s	Idaho	.07	70,000
Homestake, g	S. D.	.65	163,254
Lake View, z	Utah	.02½	11,250
May Day, g.s.l	Utah	.03	24,000
Miami, c	Ariz.	1.00	746,759
National Lead & Zinc, l.z	Mo.	.02	10,000
Nevada Wonder, s.g	Nev.	.05	70,416
New Jersey Zinc, z	U. S.	2.50	875,000
Osceola, c	Mich.	2.50	240,375
Success, z	Idaho	.03	45,000
United Verde, c	Ariz.	.75	225,000
Wasp No. 2, g	S. D.	.01	5,000
Wellington, g	Colo.	.02	200,000
Wilbert, l.s	Utah	.01	10,000
Yellow Pine, c.z.s.g	Nev.	.07	70,000
Industrial and Holding Companies	**Situation**	**Per Share**	**Total**
Cambria Steel	Penn.	$0.62½	$562,500
International Nickel, com	U. S.-Can.	10.00*	3,803,150*
International Nickel, pfd	U. S.-Can.	1.50	133,689
St. Mary's Mineral Land	Mich.	2.00	320,000
United States Steel, pfd	U. S.	1.75	6,304,919
Warwick Iron & Steel, pfd	Penn.	.35	52,035
White Knob Copper and Dev., pfd	Calif.	.10	20,000
Canadian, Mexican and Central American Companies	**Situation**	**Per Share**	**Total**
Amparo, g	Mex.	$0.03	$60,000
Dominion Steel	Can.	1.50	105,000
Granby Con., c	B. C.	1.50	224,977
Hollinger, g	Ont.	.20	120,000
Lucky Tiger, g.s	Mex.	.09	64,380
Santa Gertrudis, s	Mex.	.24	364,500
Standard, s.l	B. C.	.02½	50,000
Steel Co. of Canada	N. S.	1.75	113,750
Tough-Oakes, s	Ont.	.12½	75,000

* Stock dividend.

Hecla, which appears in the accompanying detailed table of disbursements, paid its one hundred and fiftieth dividend:

PERSONALS

C. W. Purington has returned to London from Irkutsk, Siberia.

Walter McGrath has returned to Petrograd from Central Siberia.

Thomas A. Varden is at Sault Ste. Marie, Mich., on examination work.

Sydney H. Ball has returned from a several weeks' trip to British Columbia.

H. M. Payne has returned to London from Bodaibo in the Lena Region, Siberia.

Ross Browne Hoffmann has returned to Petrograd from Tomsk; he will soon return to Siberia.

R. Gilman Brown, Deane P. Mitchell and J. P. B. Webster have just returned to London from Russia.

A. F. Gernet has returned from a visit to the Kedabeg copper mines in the Caucasus, of which he is managing director.

Diamondfield Jack Davis, and Henry Webber, both formerly prominent in Goldfield, are now operating in Oatman, Arizona.

Edmund Putnam of Parral, Mexico, and Boston, is in New York in connection with a kaolin mine near Rome, Ga., in which he is interested.

A. H. Buck is making a study of the geology of the Johnson district for the Black Prince Copper Co., and will be in Denver about Dec. 20 next.

R. H. Shields, of Houghton, Mich., president of the New Baltic and New Arcadian Copper companies has gone to Boston and New York on business.

J. P. Hutchins has returned to Petrograd after visiting the Altai region in Siberia and examining the manganese deposits of Chiaturi in the Caucasus.

Walter Strache returned to New York on Nov. 28 from Greenland where for the last six months he has been examining mineral properties on the west coast.

Manager Bart L. Thane, of the Alaska Gold Mines Co., left Juneau for San Francisco late in November to work on a mining deal that arouses much curiosity in Juneau.

J. A. Replogle, Arthur E. Newbold and Herbert F. Black have been chosen directors of the Cambria Steel Co. in place of Theodore N. Ely, Samuel T. Modine and Childs Frick, resigned.

Benjamin Magnus, formerly general manager of the Mt. Morgan Gold Mining Co. in Australia is now practising as consulting engineer. His address is care General Development Co., 61 Broadway, New York.

Professor J. H. Bragg, of University College, London, has been awarded the Nobel Prize for Physics for 1915 by the Swedish Royal Academy of Science for an examination by X-rays of the formation of crystals.

Pierre Bouery, for 15 years manager of La Grange hydraulic mine at Weaverville, Calif., has been appointed manager of the Valdez Creek Placer Mines in Alaska. Under Mr. Bouery's charge La Grange has been considered one of the most successful hydraulic operations in the world.

Word has been received from Eugene Schwaderer, one of the Michigan College of Mines students who left Houghton for South Africa in July, that the party has arrived at Messina in the Transvaal and found 20 Americans working there for the company, mostly men from Butte or Michigan.

Dr. John A. Mathews, who has been for a number of years general manager of the Halcomb Steel Co., Syracuse, N. Y., has been elected president of the company, succeeding H. S. Wilkinson, resigned. He also succeeds Mr. Wilkinson as president of the Syracuse Crucible Steel Co., a connected company.

Frank S. Badger, of J. G. White & Co., Ltd., sailed on Dec. 1 for Colombia where he will make a power reconnaissance for the Anglo-Colombian Development Co. which has under contemplation the construction of additional dredges in the Condoto gold-platinum region back from Buenaventura on the west coast.

Dr. L. D. Ricketts, of Bisbee, on account of his work in promoting the mining industry of Arizona was selected by Governor Hunt to visit the San Francisco exposition and receive an official greeting as the state's most distinguished citizen. On Nov. 17 he was the guest of the exposition directors at a luncheon in the California Building, where speeches were made by a number of mining engineers and a commemorative bronze medal was presented to Dr. Ricketts.

OBITUARY

Zachary Merton, head of Henry R. Merton & Co., London, died Nov. 30, according to a cable despatch just received.

Philip N. Shannon died suddenly in Pittsburgh, Penn., Nov. 22, aged 72 years. He was for many years a prominent oil operator being a pioneer in Pennsylvania and also holding large interests in Texas, Wyoming and Alabama.

W. J. Guthrie, formerly of Butte, Mont., died at his home near Los Angeles, Calif., Nov. 20. An autopsy is reported to have disclosed the presence of cyanide. It was stated that no physician was in attendance at the time of his death and there was some delay in notifying authorities of the death.

Orville A. Derby committed suicide in Rio de Janeiro, Brazil, Nov. 27, according to a cablegram from that city. The reason for his act is not known. Mr. Derby had served the Brazilian Government for many years as a geologist, and had been chief of the survey since 1907. He first went to South America in 1875 from Cornell University, where he had been an instructor in geology for two years following his graduation there. He was a frequent contributor on geological subjects to scientific journals. Mr. Derby was born at Kelloggsville, N. Y., in 1851. He was unmarried.

Byron Noel White died at Spokane, Wash., Sept. 11, aged 65 years. Born in St. Thomas, Ont., he worked as a young man in the Michigan copper country as a miner and prospector for a number of years, going thence to Spokane about 30 years ago. There he engaged in mining, with which he continued to be connected. He was one of the original owners of the Slocan Star mine, in British Columbia, and at the time of his death he was still largely interested in that property. He was also interested in the Pueblo mine, in Whitehorse copper camp, southern Yukon Territory, and, as well, in mining properties in Oregon. Besides, he operated in Mexico for a time. Mr. White's chief mining activities for a number of years were in connection with the development and productive operation of the Slocan Star mine, situated near Sandon, British Columbia. To acquire the Slocan Star group, which eventually comprised about a dozen mineral claims, in 1892 the Byron N. White Co. was incorporated with Byron N. White, president and general manager. Protracted and costly litigation between the Star Mining and Milling Co. as plaintiffs, and the Byron N. White Co. as defendants, during a period of about 10 years, was finally determined by a judgment of the Supreme Court of Canada, leave to appeal from which was refused by the Privy Council in England in the year 1909. The decision was against the White Co., but later, in 1911, a merger was arranged and the Slocan Star Mines, Ltd., organized to acquire and operate both properties concerned, with Byron White as one of the directors and Oscar White as mine superintendent, since which time the property has been extensively further developed. Mr. White was well known and highly esteemed throughout the Northwest and especially in British Columbia, in the future of which he was a firm believer. He leaves a widow and one son.

SOCIETIES

International Trade Conference—A conference on international trade will be held at the Hotel Astor, New York, Dec. 6-8, under the auspices of the National Association of Manufacturers.

American Institute of Mining Engineers—The next meeting of the New York Section will be held Dec. 8, at the Machinery Club, 50 Church Street. The meeting will be preceded by a dinner served at 6:30 p.m. Following the dinner the subject of "The Engineer in Modern Warfare with Particular Reference to the Present Conflict," will be discussed by several U. S. army engineers.

INDUSTRIAL NEWS

The Morse Bros. Machinery and Supply Co. has purchased the entire plant of the Kuenzel process smeltery situated at Buena Vista, Colo., and will dismantle it and ship it to Denver. This plant was never completed and only parts of it were placed in operation. There is a complete power plant of high-pressure boilers, engines, blowers, compressors, besides crushing plant, machine shop, fire and boiler feed pumps, shafting, elevators, etc.

Editorial Correspondence

SAN FRANCISCO—Nov. 24

Employment of Negroes as Mine Laborers is reported to have been undertaken in the Coso district, Inyo County. More than 25 negroes passed through Visalia Nov. 7 en route to the mines. They came from Virginia and are said to be employed by eastern men who have recently taken hold of mining property in that district. It is reported that their compensation is to be $10 per month and board. The labor in the mines in California has for a long time been done by foreigners; and foreign labor is at present not plentiful. What effect the employment of negroes will have upon the labor element is problematical. This is the first time that a full crew of negro labor has been employed at mining work in California, although the employment of negroes in various other industries is common enough.

The Filing of an Injunction in San Bernardino County to restrain the sale of 3,500 acres of potash lands at Searles Lake as part of the estate of Pliney H. Perkins, while adding another chapter to the litigation, at the same time attracts further attention to the operations of the American Trona Co. The sale of the property involved in the estate has been postponed and the matter will be heard in the Superior Court. But the American Trona Co. is going along with the development of the process for recovering the potash from the brine of the lake, regardless of added litigation. The development of the Searles Lake deposits began before the European war was thought of in America. So the location and development of China Lake basin, a few miles west of Searles Lake, was begun before the war attracted renewed attention to the potash deposit in California. Charles H. Churchill, a prospector and miner who had been on the desert half a lifetime, and who was the discoverer of tungsten in San Bernardino County, has been engaged for several years locating and developing a large acreage of ground that he believes will produce potash and borax on a large scale. Whether or not the European war continues for a long period, the development of these potash lands both at Searles Lake and China Lake will no doubt be continued in the same spirit and with the same energy.

Standard Oil Co., has taken over the Kern County property of Monte Cristo Co., also the Monte Cristo lease at Fullerton. The price is said to be $375,000, which is considered very low. There is a quarter section of the Maricopa and 40 acres at Fullerton. Total number of wells 115. Monte Cristo has produced a large amount of low-gravity oil. The Fullerton wells are deeper and produce a lighter-gravity oil. The Standard has also taken over a full section in the Antelope Hills district, Kern County, from the Oil Exploration Co., Ltd. The price is said to be $40,000. Testing operation has been in progress in the district for some time past. The Associated is very active in the Lost Hills district, having more than 100 men employed in section 13, plowing and leveling off locations for wells to be drilled. Teams and large motor trucks are working night and day in order to get material and supplies upon the ground before the winter rains start. About 20 wells will be drilled. Oil sands in this section lie 500 to 700 ft. deep. Oil is light gravity. The independent producers, while of a necessity having reduced their output in the past year, are aware that the purchases of more territory by the Standard and increased operation by the Associated is evidence of a future that cannot be destroyed even by the litigation instituted by the government. While the big companies are taking on more land and preparing for increased production, the marketing concerns are keeping their plants going largely with oil purchased from small producers. The only oil men who seem to be really discouraged are those on land that may be involved in the government litigation.

BUTTE—Nov. 25

More Development Work in Butte Mines is being carried on at present than at any time in the history of the district. On Nov. 1 the Rainbow Development Co. began work on its contract at the Butte & London. On that date the unwatering of the shaft was completed and the sinking of the shaft from the 1,100-ft. level to the 1,600-ft. level was begun. The shaft is now down close to the 1,200 level. By Apr. 1 the station on the 1,600 should be in and the entire property will then be crosscut from north to south. Sinking at the Rainbow shaft is going steadily forward and the two properties will be developed jointly. At the East Butte properties, which are to the south of the Rainbow and Butte & London, the sinking of the shaft of the Pittsmont mine came to a stop after going down a distance of 250 ft. from the 1,600 level. At that point a heavy wet fault was encountered that caused delay. The plans call for a further sinking there to the 2,100-ft. level. At the Tropic, adjoining these properties on the east, the Anaconda company will carry on sinking during the coming year and carry the shaft down to the 2,000-ft. level. The Blackrock shaft of the Butte & Superior has been carried down from the 1,600-ft. level to a depth of 1,920 ft. and crosscutting will be carried on from the 1,700-, 1,800- and 1,900-ft. levels. Sinking is now being carried on at the Butte & Great Falls property in the northeast part of the district. All of these mines are in what is known as the East and North Butte districts and in territory that has not heretofore been explored at depth. The unwatering of the Lexington, Alice, Nettie and Emma mines which is going on steadily will be followed by sinking in nearly all those shafts. Sinking at the Elm Orlu is now going forward steadily and the purpose is to carry the shaft from the 1,700 level down to the 3,000-ft. level with stations at 1,900, 2,000 and every 200 ft. below that to the lowest level. It is estimated that sinking in all the mines of Butte being carried to lower levels, is now averaging 2,500 ft. per month or a total of nearly half a mile each month in added depth to the Butte mine shafts.

The New Experimental Zinc Plant of the Anaconda company at the Washoe smeltery is claimed to be a complete success from a commercial as well as from a metallurgical standpoint. The costs, it is said, have been reduced to a point where zinc can be made at a profit even if it were to fall in price to the point where it started previous to the war in Europe. The Anaconda company is expected to proceed immediately with either the enlargement of the experimental plant at Anaconda or with the construction of a new plant in Great Falls, Anaconda or Butte. In the 10-ton experimental plant at Anaconda which was put into operation in October, three large melting pots are used. These were of old construction and limited in capacity. The company has now nearing completion a new brick furnace that will increase the capacity of the plant to 25 tons of zinc per day. This will make a monthly capacity of 1,500,000 pounds of electrolytic zinc when the new plant is operating at the full limit. Cakes of the new electrolytic zinc have been on exhibition in Butte and have attracted great interest in mining circles. This zinc is said to be of such a high grade, 99.9% pure, that it has found a ready market at a good premium by manufacturers requiring it for brass specials and munition purposes. An improvement that has been made is the use of aluminum starting sheets in the electrolytic process. Under the plan of operation adopted at first, aluminum starting plates were used to make zinc starting sheets. On each aluminum plate two zinc starting sheets were made and these in turn were taken off and used for starting the regular zinc plates in the electrolytic tanks. By using the aluminum starting sheets direct, this double handling is avoided. Two plates of zinc are formed on each aluminum starting sheet and are taken direct to the furnace after being removed from the tanks. The Anaconda company expects to have several mines with large zinc orebodies ready for operation early next year. Included in this list are the Emma which it has under lease, the Alice and the Lexington, all of which are being unwatered at present. It is now taking zinc ores for its experimental plant from the Poulin and East Gray Rock mines.

MIAMI, ARIZ.—Nov. 22

Construction at the Inspiration Mill is going on at a rapid rate. The building for the housing of all the pumps and compressors is nearly completed. The seven additional thickening tanks for the tailings-dewatering plant have yet to be installed. In the mill proper, the Marcy ball mills of nine of the 18 sections of the mill are in operation, 18 mills in all, there being two in each section. The flotation machines for the 8th and 9th sections have not been installed, the machines in the first seven sections having to treat the ore ground in the nine crushing sections in operation. The flooring for the flotation machines for the 11 uncompleted sec-

tions is now being laid and several of the cleaning flotation machines, namely in sections 8, 9, 10 and 11 are being erected, the corresponding roughing cells cannot of course be put in until the laying of the floor is completed. The machinery for the concentrating department for all sections has been installed and is ready for operation except for placing the steel drags on the belts of some of the drag classifiers. In sections 8, 10 and 11 flotation machines of the Inspiration type are being installed which are similar to the machines of sections 5, 6 and 7 except whereas those in the last mentioned sections are built of timber, the newer machines in sections 8, 10 and 11 are constructed of light sheet steel. In section 9, another type of flotation machine is being installed, built partly of wood and partly of steel. This machine will operate with agitating paddles somewhat like those used in the Minerals Separation machine, but from the appearance of the machine at present, as it is being installed, the agitation and flotation will take place in the same cell, the tank or trough of the machine being a simple rectangular box in the middle of each cell of which an agitator will hang. This type machine will make in all three types of flotation machines in the Inspiration mill, namely the Callow, the Inspiration and the agitator machines. In the flotation plant the odor of coal tar has replaced that of the eye-burning creosol and creosote.

Construction Work at the Inspiration Mine is nearly completed and for the last few weeks a general cleaning up has been under way both on the surface and underground. This work had consisted of clearing away temporary structures, litter, etc., that had accumulated during the construction period, which at the mine is now about closed. The road from Miami to the mine has been closed, making it necessary to go up to the mine by team or auto over the road that passes by the smeltery and mill. The ground to the west of the Captain shaft of the Miami Copper Co. is caving and cracks that crossed the road have been widening at a rapid rate because of the Miami company's caving operations going on underneath. The miner's change house at Inspiration is nearing completion, and will be ready for occupancy just as soon as the interior fittings have been completed. The double-deck Otis elevator, that will carry a total of 40 men, in the main west shaft is about ready for regular use, and will be used for lowering men by the time the change house is completed. This elevator is electrically lighted and is equipped with a telephone. It is operated from the deck by the cager exactly as is an office-building elevator. There are two push buttons at each station in the mine for calling the elevator for going up or down. It is said that this elevator is the fastest moving one of its kind, having been designed for a maximum hoisting speed of 850 ft. per minute. The electric controlling device installed by the General Electric Co. on the Nordberg twin-skip hoists is now in constant use. With this controlling mechanism the hoisting of the two skips in balance in each shaft is entirely automatic from the time the current is turned on at the beginning until turned off at the end of the shift; the hoisting engineer's most onerous duty is the oiling of the machinery. The hoists may be operated by hand whenever desired, the hoisting speed then being considerably greater than when operating under the automatic control. The last of the four crushing units in the coarse-crushing plant at the main hoisting shaft is now in commission; the conveying machinery on which delivery had been delayed has been installed so that the plant is now ready for operations at full capacity.

CLIFTON, ARIZ.—Nov. 20

A Petition for the Recall of Governor Hunt of Arizona, who is said to have headed a public subscription list with $500, asking at the same time that all citizens donate to the strikers' cause; who threatened to put the mine managers in the bull-pen in order to accomplish his desires regarding treating with the strikers; who issued a Thanksgiving proclamation of which this is a sample: "Today, in Arizona, whither, with phenomenal encompassment of distance, that lofty civilization inaugurated by our Puritan forefathers has advanced with irresistible tread in obedience to Destiny's decree, an intelligent, liberty-loving populace, mindful of the perpetual, omniscent guardianship of Divine Providence, adhere to a time-honored custom by gratefully acknowledging the beneficence of an omnipotent Creator with appropriate manifestations of gratitude for blessings bountifully bestowed," is being circulated in which one of the indictments is: "That the said George W. P. Hunt has deliberately attempted to foment and encourage class hatreds and divisions. That he has been partisan and prejudiced in his dealings with the most vital interests of the state and that, by a program of unconcealed and deliberate catering to the most radical elements, he has created a condition approaching anarchy in certain sections of the state."

TORONTO—Nov. 27

The Consolidated Mining and Smelting Co., of Canada, has issued a circular announcing the issue of a new block of stock, and giving a statement of the affairs of the company, which shows a remarkable expansion. The zinc output for 1916 has been ordered by the Canadian Shell Committee at profitable prices. At the request of the Shell Committee, the company has undertaken the refining of copper which will be done on a limited scale at first, but later it is expected to develop and involve the treatment of much of the matte and blister copper taken from British Columbia mines. The Shell Committee will take the output of refined copper during 1916. The capacity of the lead furnace has been taxed to its full extent during the past year, and the output is sold for six months ahead.

OTTAWA—Nov. 27

Antimony Deposits in the Wheaton district in Southern Yukon are declared by Dr. D. D. Cairnes, of the Geological Survey, who has made a thorough examination of them this year, to be among the largest antimony deposits in the world. In the White Horse copper belt the Pueblo mine, from which 100,000 tons of copper ore averaging 4% copper was shipped prior to the opening of the war, is about to begin operations again. About 100,000 tons of silver ore have been shipped this year from the Atkins mine, at Galena Creek, on the Upper Stewart River. Other promising silver properties are now being developed in the vicinity of the Atkins mine.

VICTORIA, B. C.—Nov. 22

Pacific Coast Collieries, which deferred its bond interest last May, has taken similar action again this month. The property was compelled to close down for a long period, but is now operating and the outlook for the future is better.

Silver Ingots Valued at $65,000 formed part of the cargo of the Nippon Yusen Kaisha liner Yokohama Maru on her last voyage to Hongkong. The silver was shipped via Victoria from the Consolidated Mining and Smelting Co.'s plant at Trail, B. C., and was the largest and most valuable that has yet been sent across the Pacific from British Columbia mines.

COBALT—Nov. 27

The Increase in the Price of Silver has resulted in a renewal of productive activity in the Cobalt camp, and companies which for some time have been curtailing their output and holding back shipments are now arranging to take advantage of improved market conditions by increasing production. In many cases development operations carried on steadily during the depression have put the companies in better condition for mining, so that if the present price is maintained a largely increased output may be anticipated. Mining staffs are being largely reinforced.

There is More New Exploration Work started or planned for this camp at present than there has been for several years. Much of this is by new interests not directly connected with the old successful companies and is on properties which have been partly explored in the early boom days or which have been idle after brief production under the stimulus of the boom. Most of the operations are financed from the States and they are largely in the charge of men new to the district who have been able to get control of well located properties on very good terms and who have their own private "hunch" as to where the ore is to be found. In most cases the work planned does not require a heavy capital outlay and this is presumably a feature that had caused these opportunities to become of interest again at this time. In fact, the camp has and does offer special opportunities for companies with limited capital. The hazard is very great, but the financial requirements of the work are relatively small considering the great prizes in prospect if ore is struck. Among the new projects already formed may be mentioned the Genesee, controlling a lot north of the Chambers-Ferland in the conglomerate, backed by Buffalo and Rochester people; the Twentieth Century, north of Cross Lake, near the Green-Mehan, financed in Buffalo; the Mercy, a survival of the Gould operation in the Cart Lake area, controlled by some of the Seneca-Superior crowd; the Cyril Lake or old Airgold near the Dominion, backed by St. Paul and Duluth operators; the Adanac, south of the Temiskaming and supposed to have a continuation of the Temiskaming veins, sustained by Burr Cartwright, of Buffalo; the Aguinico, on Lake Temiskaming, north of Cross Lake, being opened chiefly for its cobalt ores by C. E. Smith, of Toronto; the Green-Mehan, once well known on the stock markets, now being unwatered and examined; the Casey-Seneca, in the Casey-Cobalt area, north of the main productive area and isolated from it.

The Mining News

ALASKA

CLIFF MINE (Valdez)—Wharf being rebuilt by Manager Ellis preparatory to shipping in spring.

BARNES PROPERTY (Crowe Creek, Seward) — Richard Dawson, driving tunnel ledge, reports ore averaging $14 per ton.

TEIKHELL (Teikhell District)—Pres. Joseph McCoy reports good progress in development of mine. Tunnels are being driven to tap lead of ore.

ALASKA ENDICOTT M. AND M. CO. (Juneau)—Incorporated with capital of $1,200,000, to own, operate, deal in mines, etc. E. M. Aldrich is Alaska agent.

KOYUKUK CLEAN UP—Will be in the neighborhood of $250,000 this year according to F. E. Howard, former commissioner for that district, most of the gold coming from Hammond River.

NEVADA CREEK (Douglas Island) — M. S. Hudson in charge of mine has added 20 men to crew and will push main tunnel during winter; 800 ft. additional tunneling will be started at once.

BLACK DIAMOND GOLD (Valdez)—C. C. Reynolds, George Hobart, H. Whitney, J. Crawford, G. J. Love and L. Graham are developing this property and report striking a 21-in. lead of free-milling ore.

SPEEL RIVER PROJECT (Juneau)—P. B. Dawson, connected with construction plans of Project has recently been at Speel River looking over proposed work. Reported that work will start in spring.

ALASKA GASTINEAU (Juneau)—During September 500,000 tons of ore were broken in Perseverance stopes. Mill at Thane milled 160,000 tons. Total cost of mining and milling under 60c. per ton. Original estimate was 75c. per ton. At Annex Creek Water-Power Project, water should be turned through power house by end of year. Tunnel finished and concreting well under way. A. G. M. Co. settled with H. T. Tripp of Juneau for water rights on Annex Creek and Carlson Creek for consideration of $10,000.

ARIZONA

Cochise County

CALUMET & ARIZONA (Bisbee)—Has leased a large tract of mineral land about 16 mi. east of Fort Stockton, Texas. Ostensibly, acquisition was made for purpose of drilling for oil, but there is opinion prevalent that it is sulphur the company is after. New Cornelia, a C. & A. subsidiary, has developed at Ajo, Ariz., large body of low-grade oxidized copper ore and is building big leaching plant. It is to supply this plant with sulphuric acid that sulphur is wanted. Local well-driller will immediately start to put down two 500-ft. holes.

Gila County

IRON CAP COPPER (Copper Hill)—Produced in October 179,847 lb. of copper at a cost of 9.3c. per pound. Net earnings were $15,065. For six months ended Oct. 31, made net profits of $85,274. Shaft is down to 900-ft. level, where station is being cut.

Greenlee County

FEDERAL INVESTIGATION of causes leading up to the Clifton strike began at Clifton, Nov. 22, following arrival of two commissioners of the Department of Labor.

THE WOMEN OF GLOBE AND MIAMI will aid the strikers' families at Morenci, Clifton and Metcalf by raising money through an entertainment and county fair to be given at Central Hall in Globe.

Mohave County

UNITED EASTERN (Oatman)—Final steps taken at annual meeting of stockholders looking toward immediate start of construction of 200-ton cyanide plant, to be increased later to 400 tons per day. Frank A. Keith is president, and D. C. Jackling and Seeley W. Mudd are on the board of directors.

CALIFORNIA

Amador County

RHETTA (Plymouth)—Grading for installation of machinery has begun and mine will be reopened. It was former producer.

MAYON (Amador City)—Sinking is progressing with view of thoroughly prospecting ground by drifting. Thomas C. Mayon is owner.

FREMONT (Dry Creek)—Reported that unusually rich ore has been disclosed in lower levels. Mine is and has been for number of years producer and dividend payer. Wales Palmer is superintendent.

PLYMOUTH CONSOLIDATED (Plymouth)—Preliminary statement for October shows 11,000 tons of ore milled, total value, $54,499; working costs, $29,301; development expenditure, $3,328; surplus, $21,870.

Butte County

FORBESTOWN CHROME shipped by Western Pacific, having been wagon-hauled to Oroville. Shipment amounted to 45 tons; mined on property of California Hardwood Lumber Co.

Calaveras County

CALAVERAS COPPER (Copperopolis)—Installation of new mill progressing; expected to be ready for operation in December; 90 men employed in mine and mill.

Eldorado County

JUDSON (Diamond Springs)—Pumping plant installed for unwatering shaft. Property has yielded large amounts in pocket gold.

MONTEZUMA (Nashville)—Plymouth Exploration Co., of Amador County, is putting mine in shape for active operation, sinking double-compartment shaft at rate of 80 ft. a month; now down 500 ft.; will be deepened to 1,200 ft. before drifting; 3 shifts and 20 men employed.

Modoc County

SUNSHINE (Highgrade)—Schauer lease is sacking high-grade ore and hauling to New Pinecreek. Expect to have carload by Christmas.

Nevada County

MEADOW LAKE (Colefax)—George Cooper and Tom Harris have bonded property to Theodore D. Robinson, of Lakeport, N. Y.

GOLDEN CENTER (Grass Valley)—Reported that payment of $18,000 has been made by company to Nicholas Berriman for Dromedary claim which was located in 1850 and worked in early days.

MEDICAL EXAMINATIONS of miners ordered by North Star and Empire and Pennsylvania mines. Under recent amendments to law, employers are now responsible for care of men affected by occupational diseases.

Plumas County

WALKER COPPER (Portola)—Flotation plant, 100 tons capacity, being installed at mines near Portola. Expected to be in operation early in January. Construction of 4,600-ft. aërial tramway in progress; surface buildings being erected.

SOUTHERN EUREKA (Greenville)—Reported that George D. Needy, of Spokane, and other Washington men have purchased this property, including Hibernia and McClellan mines; also the Wardlow group adjoining Southern Eureka. Property embraces about 450 acres in center of Greenville district and is surrounded by producing mines. Installation of modern mill contemplated.

Sierra County

WISCONSIN (Forest City)—Gold nugget weighing nearly 9 oz. found, also quartz boulders thickly studded with gold. Many rich nuggets found here in past. Property operated by Wisconsin-North Fork Mining Co. through same shaft as old North Fork gravel mine. G. F. Stone, manager.

Shasta County

MAMMOTH (Kennett)—New copper orebody reported in gossan croppings north of the Mammoth proper. Development at this point was undertaken for purpose of securing quartz ores.

Tuolumne County

HOPE (Sonora)—Air-driven pumps and air drills are to be installed; 12 men are employed in development work. Property is owned by Salt Lake City men. George W. Weston is general manager.

RAWHIDE (Jamestown) — Large amounts of machinery and supplies being received from Blair, Nev., by Silver Peak Mining Co., which recently purchased property. Said to be purpose of company to move entire plant from Blair to Jamestown.

COLORADO

Clear Creek County

MARY MINES AND LEASING (Idaho Springs)—This company, composed of local operators, has started development on Mary vein. Work will be carried on through Big Five tunnel.

IMPERIAL MINES (Georgetown)—Lessees operating on Centennial vein have opened 14-in. vein of $50 ore for distance of 70 ft. Operations are being carried on through Wilcox tunnel.

CAPITAL CENTRAL (Georgetown) — Development which has been in progress during past few months has disclosed body of milling ore which will probably be shipped to Linn mill for concentration.

SPECIE PAYMENT GOLD (Idaho Springs)—Systematic development is to be resumed in this company's property on Bellevue Mt. and preliminary operations are under way. New work is under direction of E. J. F. Coleman who is president and manager of the company.

Teller County

C. O. D. (Cripple Creek)—Lessees Parsons and Vetters, operating on 10th level, have made rich strike. Discovery was made in raise extended from 10th level at point about 750 ft. north of the shaft. Pay streak is 30 in. wide and is composed of quartz and fluorite. Assays indicate value of about $150 a ton. Discovery is on what is considered split from main C.O.D. vein and is about 800 ft. below surface.

IDAHO

Shoshone County

IMPERIAL (Wallace)—Operations have been resumed in lower workings, 720 ft. below upper workings and 1,300 ft. below surface. John H. Nordquist is manager.

GUELPH (Wallace)—New shaft down 25 ft. Sinking is by hand, but company plans to install compressor and drills, taking current from lines of Washington Water Power Co.

LITTLE PITTSBURGH (Kellogg)—Compressor delivered at property, which is under bond to Colonial Mining Co. Electric power line has been extended to run compressor. Property opened by crosscut 650 ft. and drift on vein 40 ft. shows 20 ft. of zinc ore, 2 ft. of which assays 47% and balance 26%. Company will ship high-grade ore, delivering it to wagon road by tramway and hauling to railroad about 8 mi.

EMPIRE (Little North Fork)—Compressor has been delivered to this property, formerly known as Horst-Powell, and power lines are being extended to mine by W. W. Power Co. Company has considerable ore blocked out and plans mill in spring. Several shipments made during summer.

BOSS ZINC (Osburn)—Has about 2 ft. zinc-lead ore in short crosscut from bottom of shaft. Much development work in that section for many years has failed to disclose commercial ore, although surface indications and formation are highly favorable. Strike on Boss is therefore of more than usual interest.

SNOWSTORM (Mullan)—Rumor that Snowstorm company had taken over Banner & Bangle property at Troy, Mont., denied by Leo Greenough, manager, who states that Snowstorm has two other properties under consideration. Greenough interests have been developing Banner & Bangle for several years and plan construction of 300-ton mill next spring. Ore is lead-zinc.

SUNSET (Wallace)—This property, acquired many years ago by ex-Senator W. A. Clark, of Montana, which has been under active development by him during recent years, is to have new electrically driven compressor and hoist. Present power is gasoline, with which shaft has been sunk 400 ft., with drifts east and west at 200 and 400. Shaft will be sent deeper with new plant. Has large body of low-grade lead and zinc ore.

GALENA GROUP (Wallace)—Situated on Ninemile west of Success, will be developed by Cœur d'Alene M. and S. Co. Winze sunk to depth of 60 ft. from short upper tunnel, disclosed promising body of galena and carbonate ore; work in winze was stopped because of difficulty of handling water. Second tunnel was driven at 500 ft. lower elevation, cutting vein 900 ft. from portal. Company will drive on vein 400 ft. to get under winze.

RED MONARCH (Wallace)—Red Monarch Consolidated Mining Co. has been organized, combining Red Monarch, Rawhide and Emerald groups of claims in Beaver district. Spokane men are controlling factor in organization and are now preparing for extensive development. Two well-defined veins will be explored, one of them running in an easterly and westerly direction and the other north and south. Contract has also been made with diamond-drill company to do 8,000 ft. of exploration.

MICHIGAN

(Iron)

YOUNG (Iron River)—New lease has been granted. Mine will be unwatered and worked this winter. This is one of last mines in Iron River field to be reopened.

METEOR (Ironwood)—Shaft-sinking will be resumed here. Depth of about 200 ft. was reached when work was stopped two years ago. Considerable work must be done before ore is reached.

CLEVELAND-CLIFFS IRON CO. (Ishpeming)—Last boat was loaded Nov. 23. Cargo was from Republic mine. Snow hindered loading operations at mines. Company shipped more than 2,225,000 tons. Most of other Marquette range companies are also through for year.

CLEVELAND-CLIFFS IRON CO. (Ishpeming)—A shaft is to be sunk on Junction Forty and ore removed. This land adjoins Section 16 mine of Oliver Iron Mining Co. Latter company worked to Junction line. Intention was to have Oliver remove ore. This could not be done, as Section 16 shaft is handling all ore it can. Diamond drills are at work on surface and underground in Sixteen to locate best place for new shaft. Deposit is large and of good grade.

FORTUNE LAKE MINING CO. (Crystal Falls)—This company will not go ahead with its development work at present. Contractors have stopped their work of changing course of Briar Hill Creek. No houses will be erected. Two big shafts will not go down. Lands were drilled first with churn drills. Later, few diamond-drill holes were put down. It is reported that the ore showed from 1 to 3% sulphur. This would make it of little value at this time. All of lands have not been explored. More drill work will be carried on shortly.

MINNESOTA

Duluth

ZENITH FURNACE CO. (Duluth)—Now manufacturing benzol and tuluol as byproducts of coke manufacture.

RALSTON STEEL CAR CO.—Company negotiating for site for $2,000,000 plant near the Minnesota Steel Co. plant at Duluth. Present plant and office are at Columbus, Ohio.

Cuyuna Range

CUYUNA-MILLE LACS (Ironton)—Season's shipments will total 40,000 tons. Product, high-manganese iron ore, with 10 to 35% manganese content.

BREITUNG (Crosby)—After loading all equipment on cars and abandoning operations, orders were received to resume work at this development shaft.

Mesabi Range

BELGRADE (Elba)—New shaft being sunk and new station will be cut.

BANGOR (Aurora)—Shaft now down 300 ft. will be sunk to greater depth during winter.

SECTION 27 (Chisholm)—Engine and dynamo being erected preparatory to installing electric-haulage system.

CLARK (Chisholm)—Steam-heated pockets being installed at shafthouse to prevent ore from freezing before loading. Shipments to be made throughout the winter to the Minnesota Steel Co. at Duluth.

MISSOURI—KANSAS—OKLAHOMA

TEMPLE CHATMAN (Miami, Okla.)—Has let contract for drilling of several hundred acres southwest of Miami.

GREENFIELD & LOCKWOOD (Lawton, Kan.)—Has new 150-ton mill about ready to start. Expects to have ground drained by time mill is ready to run. Had to increase pumping capacity.

LOCKPORT MILL (Galena, Kan.)—Important improvements being made at mill, situated on James Murphy land. Three of latest model sludge tables being installed. Mill runs exclusively on custom work. Will be ready for operation in about four weeks. William Crockett is superintendent.

LUCKY GEORGE (Joplin, Mo.)—R. C. Watson, superintendent. Building new 200-ton mill. The company has 15-acre lease on Lindeman tract of land at Bell Center, northwest of Joplin. Two shafts already in ore; expect to have both of them opened up ready for operation by time mill is completed. Trial runs at custom mill showed that dirt would run 10% zinc ore.

AYLOR (Joplin, Mo.)—A 300-ton mill is going up on Aylor land. E. A. C. Elliott is superintendent. Two pumps have been running for some time to drain ground. Present work will be conducted at 180-ft. level, where good run of ore has been encountered, but good pay dirt is claimed to extend to 230-ft. level. Company has drilled eight holes, all of which are said to show same ore that is now being opened up in mill shaft at 180-ft. level.

MONTANA

Lincoln County

MINING ACTIVITY NEAR TROY—Leo Greenough, well known mining man, is preparing for considerable activity on Grouse Mountain, few miles south of Troy, where he is operating B. & B. mine. Projected electric railroad from Troy to mine will be constructed immediately and mill of sufficient size to handle big output will be put up. Mr. Greenough has secured options on other mining claims on Grouse Mountain.

Silver Bow County

BUTTE-ALEX SCOTT (Butte)—Earnings for October were slightly over $30,000 or an average of over $1,500 per day for 20 days which mine was operated. November will show still better results according to advices from mine.

BUTTE-BALLAKLAVA (Butte)—October earnings were over $1,000 a day, best showing made since company took over management at time leasers were working property. Ore hoisted averaged more than 4½% copper and was mined from levels between the 1,300 and 1,600. Crosscutting is being done on 2,200 level.

LILLIE MINE (Butte)—On Nov. 24 Judge McClernan entered decree for partition of Lillie claim between North Butte and Butte-Main Range companies. Latter owns five-sixths, former one-sixth of Lillie claim. By agreement Butte-Main Range gets what is known as north portion of claim, containing 7.817 acres. North Butte gets southern portion, containing 8.811 acres. Being worth more than north portion, North Butte is to pay $30,000 to Butte-Main Range company.

BUTTE & SUPERIOR (Butte)—According to quarterly report for three months ended Sept. 30, net earnings were $2,761,839. Ore mined and milled, 130,210 dry tons, averaging 17.147% zinc and resulting in production of 37,396 tons of concentrates averaging 55.123% zinc, corresponding to recovery of 92.33%. Mining costs were $3.46 per ton, milling costs $1.77 per ton. According to report filed in federal court 43,000 tons of ore were treated in Minerals Separation plant during October at cost of $2.75 a ton, to recover 10,473 tons of concentrates valued at $79.77 a ton.

ANACONDA (Butte)—Butte mines of Anaconda were compelled to close down two days during last week on account of surplus of ore that it was impossible to handle at Washoe and Great Falls reduction plants of company. Average daily production of 19 operating shafts of company is 13,600 tons of ore. Two-day shut down enabled smelters to catch up and it is not anticipated that any further curtailment of mining output will be necessary as improvements at both Anaconda and Great Falls will be completed soon after Jan. 1 and capacity of smelting plants increased by 20%. While most of ores from Butte are going to Anaconda, Great Falls plant is helping out materially. Three sections of old concentrator which was shut down year ago with expectation that it would never be started again, are caring for 1,500 tons of ore daily and making about 500 tons of concentrates. Six of the eight sections in old concentrator plant at Anaconda have been reconstructed and work on two remaining sections is being rushed. By Jan. 1 it is estimated that Great Falls and Washoe plants will be able to handle daily output from Butte mines of Anaconda company of 15,000 tons and copper production will be raised to above 25,000,000 lb. per month. Officers of company expect that copper production for next year will reach 300,000,000 lb. Neversweat mine, last of large operating shafts of company that is shut down, is now in readiness to start up at any time that conditions require it. New hoist is in position and shaft has been retimbered its entire length, making it one of best-equipped mines of district.

NEVADA

Esmeralda County

JUMBO EXTENSION (Goldfield)—October production was 3,476 tons; gross value, $112,000. Total mining costs were $16,000. Sampling, freight and treatment amounted to $32,000 and smelting losses $14,000. Net realization for month, $50,000. Velvet shaft is now down 700 ft. and connections will be made with present workings on 780, 860 and 1,017 levels.

Humboldt County

NEVADA PACKARD (Rochester)—New mill being tuned up; crushing ore. Mine has produced 2,300 tons of ore, average value $48.21 per ton, and there are 36,000 tons, average value of $15, blocked out. There are 7,000 tons already broken ready for the mill.

ROCHESTER MINES CO. (Rochester)—Friedman tunnel has cut vein at depth of about 1,300 ft. exposing 44 ft. of vein

matter, several feet of which is of good milling grade. Level of tunnel is about 700 ft. below bottom of workings from which present production is being made. It is estimated that November production will be $55,000.

Nye County

TONOPAH ORE PRODUCTION for week ended Nov. 20 amounted to 10,093 tons valued at $207,634 compared with 9,189 tons week previous. Producers were: Tonopah Belmont, 2,998 tons; Tonopah Mining, 3,150; Tonopah Extension, 1,850; West End, 612; Jim Butler, 1,050; North Star, 53; and miscellaneous leasers 380 tons.

TONOPAH BELMONT (Tonopah)—During October 12,342 dry tons of total net value of $142,206 were milled, resulting in profit of $65,069.

TONOPAH MINING (Tonopah)—During October mill treated 12,435 tons; average value of $12.80 per ton, resulting in profit of $60,700.

JIM BUTLER (Tonopah)—October production was 4,604 tons resulting in profit of $27,067, compared with $22,232 profit for September.

TONOPAH EXTENSION (Tonopah)—Profits for October amounted to $66,000, compared with $52,000 for September. Increased profit due largely to excellent conditions at No. 2 shaft where stoping continues from 750 to 1,350 levels. Crosscut from 1,540 level of Victor shaft should cut Murry vein within next 140 ft.

Storey County

CROWN POINT-BELCHER (Gold Hill)—Saved 235 cars milling ore from 1,600 level. Jacket mill treated usual tonnage and shipped bullion.

MEXICAN (Virginia)—East crosscut 2,700 level in porphyry and quartz of low assay at 33-ft. point. Winze in east crosscut No. 2 sunk to 11-ft. point; 2- to 4-ft. vein matter, from low assay to $30 per ton. Reopening west crosscut on 2,500 level. Mill crushed 162 tons custom ore, average assay $29.74 per ton.

UNION (Virginia)—Top of raise in No. 1 stope 2,500 level in ore assaying $21 per ton. Saved 55 tons, average assay $26.70 per ton. Northwest drift from sill floor in low-grade ore. From south end No. 3 stope 2,500 level saved 68 tons, average assay $43.71 per ton. Wedge rock saved from north end of stope in cutting out for timbers.

OPHIR (Virginia)—Low-grade quartz in south drift 2,500 level. At 145-ft. point south of winze 4 ft. of low-grade quartz. Central tunnel 250 level north drift shows 8 ft. of ore in face. Saved 365 cars of ore from stopes above north and south drifts. Milled 328 tons. Advanced Con. Virginia and Ophir west crosscut on 2,700 level to 70-ft. point.

NEW MEXICO

Dona Ana County

VICTORIA MINING AND SMELTING CO.'S silver-lead holdings were bought by C. T. Boyd, of Los Angeles, at sale ordered by U. S. District Court to satisfy bankruptcy proceedings. Properties comprise about 1,000 acres of mineral lands in two groups about 20 mi. apart. Southern group is between Organ and San Andras mountains and the northern group is situated in the Plomo district in San Andras about 35 mi, northeast of Las Cruces. New company will start extensive developments immediately.

UTAH

Beaver County

CEDAR TALISMAN (Milford)—Since beginning shipments of zinc ore from 600 level, company has produced 10 cars ore carrying about 30% zinc.

NORTH AMERICA (Milford)—Work is to be resumed at this property adjoining Croff mine on south. Ore carrying lead and silver is exposed on 180-ft. level.

GALENA (Frisco)—Work has been resumed at this property near Horn Silver. Tunnel is being driven to cut fissure productive of lead-silver ore in past years. Tunnel is in 185 ft., with about 200 ft. to go.

Juab County

MAY DAY (Eureka)—Small cyanide plant operated by Griggs, Carter & Castleton on ore from May Day dump has been closed down for winter.

TINTIC STANDARD (Eureka)—Preparations for sinking new working shaft being made. This is to do away with lack of air in the lower workings, property having only one opening to surface.

YANKEE (Eureka)—Second car of ore has been shipped from recent strike near surface. This is reported to have carried 180 oz. silver and $6 to $8 in gold, making value for 50-ton car about $4,500.

LOWER MAMMOTH (Mammoth)—Zinc ore is being mined cn 1,500, 1,700 and 1,800 levels. During September 3 cars were shipped and 2 in October. Company has good surplus in treasury. Copper and lead-silver ore being mined on 1,000 level.

IRON BLOSSOM (Silver City).—New deposit of copper ore opened in winze from 600 has been drifted on 70 ft. Several shipments have been made from here, but no stoping has yet been started. New stope has been opened in north end of mine on 500 level.

EAGLE & BLUE BELL (Eureka)—Practically all of stock of Victoria company has been turned in in exchange for Eagle & Blue Bell stock. It is probable that as soon as new equipment at latter property has been installed, work through Victoria shaft will cease, and development in that ground will be carried on through Eagle & Blue Bell workings.

COLORADO (Silver City)—$60,000 in stocks, securities and personal checks has been turned over to the clerk of the United States district court to satisfy judgment in the suit of J. L. Wilson against company for alleged deferred dividends. Sum is to satisfy all claims and liens against company, various attorneys' liens having been filed for division of judgment. Division will be made without participation of defendant company. Decision in favor of company by local Federal court was reversed by circuit court of appeals.

Salt Lake County

UTAH CONSOLIDATED (Bingham)—This company is shipping 250 tons of lead ore daily, in addition to shipments of copper ore.

CARDIFF (Salt Lake)—Work is being done with machine drills, since electrical equipment and new 8-drill compressor have been installed. Tunnel is being straightened and laid with 25-lb. rail. Electric haulage is to be used. Shipments are being maintained at rate of 125 tons daily, and it is thought that roads can be kept open during winter.

Summit County

PARK CITY SHIPMENTS for the week ended Nov. 20 amounted to 1,300 tons, valued at $52,000, as compared with 1,078 tons week previous.

NEW YORK BONANZA (Park City)—Work will soon be resumed here.

SNAKE CREEK TUNNEL (Park City)—Progress during October amounted to 312 ft., making total length 13,025 ft.

SILVER KING CONSOLIDATED (Park City)—From 30 to 40 tons of high-grade ore are being shipped daily. A two-mile tunnel is being considered to develop western end of ground.

THREE KINGS (Park City)—Company has sunk double compartment shaft 600 ft., and has drifted 400 ft. to south. The work is at present in limestone, and drift is being driven to reach contact with underlying Ontario quartzite. Electric hoist, electrically driven compressor, etc., is being used. The company owns 160 acres, adjoining Silver King Coalition and Silver King Consolidated. Operating shaft is in Nigger Hollow. E. S. Fisher is general manager.

Utah County

AT AMERICAN FORK, throughout the winter season, it is expected that a larger number of properties than usual will continue work. Lessees at the Pacific have recently shipped car of lead-silver ore of good grade, and fissure carrying lead-silver ore also is reported to have been cut at Bellerophon.

Washington County

AT THE NEW GOLD CAMP OF GOLDSTRIKE in the former Bull Valley district near Modena work continues. At Hamburg, whose strike of rich gold ore near surface was cause of recent activity in district, middle tunnel is being driven to cut ore in winze from upper workings. New ore is reported in Goldstrike Virginia, Primers Fraction and Goldstrike Bonanza.

CANADA

British Columbia

SALMON-BEAR RIVER GROUP (Portland Canal)—Main adit tunnel is now in 350 ft. and is expected to reach orebody in another 150 ft. Group is under bond to H. R. Plate, of New York.

CANADA COPPER CORPORATION (Greenwood)—Has taken up subject of new financing for construction of new plant to cost $2,000,000. Engineers report that there have been developed to date at Copper Mountain 8,900,000 tons of "proven" ore averaging 1.75% copper and 2,000,000 tons of "partially" proven ore averaging 1.75%, or a total of 10,900,000 tons, and an estimated 20c. recoverable per ton in gold and silver. Erection of 2,000-ton plant is recommended. Canadian Pacific engineers are assured of advisability of running a spur to mines from Princeton, 12 mi. Greenwood ores are smelted direct, whereas Copper Mountain ores are of disseminated porphyry type and will require concentration by flotation process.

Ontario

LAKE SHORE (Kirkland Lake)—Is again in operation. Sinking to 300 is being carried on.

TEMISKAMING (Cobalt)—Mill has 40 stamps but only 20 have been running; remaining 20 are to be put in commission.

SCHUMACHER (Porcupine)—Has sunk main shaft to 600 level. Two hundred thousand shares, par value $1, are to be put on market at 50c. a share.

SENECA-SUPERIOR (Cobalt)—Operating costs are only about 5c. per oz. Statement as of Nov. 20 showed cash in bank of $180,000 in addition to $59,500 received for sale of ore.

McINTYRE EXTENSION (Porcupine)—Has reached the 850 level. Some ore has been developed and will be treated in the McIntyre mill when the additions are completed, which will be about the first of year. Mill capacity will be increased 50%.

HOLLINGER (Porcupine)—Contract for headframe over central shaft has been let to Dominion Bridge Co. Winding engine to be installed here will be of 5,000 tons' capacity raising 5-ton skips and capable of raising ore from depth of 3,000 ft.

HURONIA (Larder Lake)—Option on this property held by Canadian Mines and Finance Co. has been allowed to lapse. Considerable work was done on property and fair quantity of ore developed. Oreshoots were short, however, and amount of money involved was large in comparison with value of ore.

PLENAURUM (Porcupine)—Has been unwatered and is now being sampled by engineers from La Rose mine. If examination is satisfactory, La Rose will purchase 59,300 shares of treasury stock at $1 share; money to go into development. After expenditure of this money sufficient vendors' stock can be purchased to give control.

MEXICO

Sonora

GREENE-CANANEA (Cananea)—One section of concentrator was equipped with apparatus of the Minerals Separation, Ltd., process several months ago, but the mill-run from July to mid-September, between enforced shutdowns, was not long enough to demonstrate what the process would do on ores from the Cananea-Duluth mine, which will constitute the principal tonnage on which flotation will be tried out.

The Market Report

Metal Markets

NEW YORK—Dec. 1, 1915

In all of the principal markets there was diminished activity and a tendency toward softening of prices, with the exception of lead.

Copper, Tin, Lead and Zinc

Copper—The demand for copper began to wane early in the week and in the latter portion the market became rather dull, although some round lots were sold on Tuesday. The aggregate volume of business transacted during the week was materially less than in the previous week. However, the total of November business was very large, perhaps as large as that which was done in June, which was a remarkable month. Early in the week some copper was sold at 20c., r. t., but the market never became fully established at that figure, sales being made at the same time at 19¾c., r. t. Within the range of 19¾@20c., r. t., producers were disposed to accept any bids that were made to them, and also any reasonable opportunities to dispose of copper abroad regardless of just what foreign sales might net. Business in England was taken at about £98 throughout the week. There was a tendency to accept bids for copper to be delivered later than February at slightly lower terms than for delivery during the immediate quarter. In the latter portion of the week copper was to be had so freely at 19¾c., r. t., that the terms of 20¼ and 20c. which were asked by some producers no longer cut any figure in the market.

Copper Exports for the week ended Nov. 13 are reported by the Department of Commerce at 18,874,973 lb. The larger items were 9,650,928 lb. to France, 4,831,591 lb. to Italy, 1,805,897 lb. to England and 1,459,788 lb. to Sweden. Imports were 2,739,439 lb. metal and 2,883,574 lb. in ore and matte; 5,623,013 lb. in all. The chief imports were from Chile, Cuba, England and Japan.

Copper Sheets, base price is 25c. per lb. for hot-rolled and 26c. for cold-rolled, with usual extras. Copper wire is 21@21½c. per lb., carload lots at mill.

Tin—Business was light and the market was very narrow. Orders to buy or sell even in moderate quantities would influence it sharply one way or the other. The deliveries in November were relatively small, being only 2.975 tons—2,575 on the Atlantic Coast and 400 on the Pacific Coast.

Tin output of the Federated Malay States is reported at 40,487 long tons in 1914, and 38,636 in 1915; decrease 1,851 tons.

Imports of tin ore and concentrates in Great Britain in October were 3,210 long tons; of which 2,494 tons were from Bolivia and 494 tons from Nigeria.

Tin arrivals at Pacific ports of the United States 11 months ended Nov. 30, were 1,412 long tons, being 117 tons less than last year.

Lead—The firmness of the market in St. Louis and the narrowness of difference between the prices at St. Louis and at New York would normally foreshadow an advance in New York. The A. S. & R. Co. maintained its price of 5.25c., but independents made sales at 5 to 10 points higher. The freight congestion on the railways entering New York is playing a part in the New York lead market, shipments of lead from St. Louis to New York being considerably longer on the way than normally.

The prices of the American Smelting and Refining Co. for desilverized lead delivered in several markets are as follows: St. Louis, 7½ points under the New York price; Chicago, 5 points under; Detroit and Cleveland, 2½ points over; Pittsburgh and Philadelphia, 5 points over.

Spelter—Producers reported relatively small business in the early part of the week, after which there was utter absence of demand, and the market passed largely in the hands of dealers. There was a weakening tendency right through the week and on Dec. 1 a distinct softening. The large difference between the prices for prompt and later deliveries continues, producers being willing to accept relatively low prices for deliveries a little way forward.

The Russo-Asiatic Corporation expects to have one unit of the zinc-smelting plant that is to treat the ore of the Riddersk mine ready for operation next March.

Zinc Sheets are in good demand, but have not advanced this week, and the base price today is $22 per 100 lb., f.o.b. Peru, Ill., less 8% discount.

Other Metals

NEW YORK—Dec. 1

Aluminum—The market shows no change, metal for early delivery being scarce and in good demand. The current price is 58@62c. per lb. for No. 1 ingots, New York. Futures are not quoted.

Antimony—The market remains strong, and there have been some fair-sized dealings. Ordinary brands, chiefly

DAILY PRICES OF METALS IN NEW YORK

Nov. Dec.	Sterling Exchange	Silver, Cts. per Oz.	Copper	Tin	Lead		Zinc
			Electrolytic, Cts. per Lb.	Spot, Cts. per Lb.	New York, Cts. per Lb.	St. Louis, Cts. per Lb.	St. Louis, Cts. per Lb.
25	.....	...	.....	..	.....	.....	.....
26	4.6913	56	19.50 @19.75	39	5.20 @5.22½	15.50 @18.50
27	4.6963	56½	19 50 @19.75	39	5 25 @5 30	5.20 @5.22½	15.50 @18.50
29	4.6963	56⅞	19.50 @19.60	39¾	5.25 @5.30	5.20 @5.22½	15.50 @18.00
30	4.6950	56⅞	19.50 @19.60	39½	5.25 @5.35	5.20 @5.22½	15.50 @18.00
1	4.7113	56½	19.50 @19.60	39	5.25 @5.35	5.20 @5.22½	14.50 @17.50

The quotations herein are our appraisal of the average markets for copper, lead, spelter and tin based on wholesale contracts for the ordinary deliveries of the trade as made by producers and agencies; and represent, to the best of our judgment, the prevailing values of the metals, reduced to basis of New York, cash, except where St. Louis is given as the basing point. St. Louis and New York are normally quoted 0.17c. apart.

The quotations for electrolytic copper are for cakes, ingots and wirebars. Electrolytic copper is commonly sold at prices including delivery to the consumers and is subject to discounts, etc. The price quoted for copper on "regular terms" is the gross price including freight to the buyer's works and is subject to a discount for cash. The difference between the price delivered and the New York cash equivalent is at present about 0.20c. on domestic business. The price of electrolytic cathodes is 0.05 to 0.10c. below that of electrolytic. Quotations for lead represent wholesale transactions in the open market for good ordinary brands. Quotations for spelter are for ordinary Prime Western brands. Only the St. Louis price is herein quoted, St. Louis being the basing market. We quote the New York price at 17c. per 100 lb. above the St. Louis price.

Silver quotations are in cents per troy ounce of fine silver.

Some current freight rates on metals per 100 lb. are: St. Louis-New York 17c.; St. Louis-Chicago, 6.3c.; St. Louis-Pittsburgh, 13.1c.

LONDON

Nov.-Dec.	Silver	Copper				Tin		Lead		Zinc	
		Standard		Electrolytic							
		Spot	3 Mos.	£ per Ton	Cts. per Lb.	Spot	3 Mos.	£ per Ton	Cts. per Lb.	£ per Ton	Cts. per Lb.
25	26¼	80	80½	98½	20.66	166½	166	28⅜	6 01	102	21.39
26	27	81	81½	98½	20.66	168½	167¾	28¾	6 03	105	22.10
27	27¼	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
29	27 5/16	80¼	80¾	99	20 76	168¾	167¾	28¾	6.03	105	22.12
30	27 5/16	79½	80	99½	20.86	168	167½	29	6 09	104	21.81
1	26 13/16	80	80½	99½	20 95	166¼	165½	28¾	6.09	99	20.86

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2240 lb., except silver which is in pence per troy ounce of sterling silver, 0.925 fine. Copper quotations are for standard copper, spot and three months, and for electrolytic, price for the latter being subject to 3 per cent. discount. For convenience in comparison of London prices, in pounds sterling per 2240 lb., with American prices in cents per pound the following approximate ratios are given, reckoning exchange at 4.80. £15 = 3.21c.; £20 = 4.29c.; £30 = 6.43c.; £40 = 8.57c.; £60 = 12.85c. Variations, £1 = 0.21⅜c.

Chinese, are selling around 40c. per lb. for large lots, while up to 42½c, has been named on some smaller business. Cookson's is nominally held at 52c., with very little to be had.

Antimony ore is available only in small lots and $2.40@2.50 per unit is named.

Quicksilver—Stocks are not large and prices are at a high level still and are advancing. New York price is $110 per flask of 75 lb. for large lots and $110@115 for smaller orders. San Francisco reports by telegraph $105 per flask, with very small stocks. London price continues £16 10s. per flask, with no discount from second hands.

Minor Metals—Current quotations for **Bismuth** are $3 per lb., New York.—**Cadmium** is quoted at 7s. per lb. in London; $1.75@1.90 per lb., New York.—**Chromium metal,** 75c. per lb., New York.—**Cobalt metal,** 97% pure, is sold at $2 per lb.—**Magnesium,** pure, has gone to a high price, $6 per lb. being asked.—**Selenium** varies from $2.50@3 per lb., New York, for large lots; $4.50@5 for retail quantities.

Gold, Silver and Platinum

NEW YORK—Dec. 1

Gold and silver movement in the United States 10 months ended Oct. 31 is reported by the Department of Commerce as follows:

	Gold		Silver	
	1914	1915	1914	1915
Exports	$207,958,750	$15,874,980	$42,453,190	$40,795,086
Imports	45,886,949	345,560,373	20,515,394	28,504,357
Excess	E.$162,071,801	I. $329,685,393	E. $21,937,796	E. $12,290,729

Exports of merchandise for the 10 months are valued at $2,867,123,745; imports, $1,450,624,406; excess of exports, $1,416,499,339. Adding the gold and silver gives $1,052,585,421 as the total export balance.

For the 10 months ended Oct. 31 imports of gold at San Francisco increased from $4,091,964 in 1914 to $54,033,016 in 1915; the gain being due chiefly to receipts from Japan. Exports were $461,995 for the 10 months.

Platinum—The market is still uncertain and prices high. Dealers are unwilling to make regular quotations, and there are negotiations over almost every transaction. Sales have been made as high as $70 and even $74 per oz. for refined platinum and up to $77@78 per oz. for hard metal.

Our Russian correspondent writes under date of Nov. 5 that a persistent demand both from abroad and for the internal market continues. The prices have again increased. The offer of metal is less than the demand and therefore higher prices are expected. From Ekaterinburg it is reported that, owing to the high prices, abandoned mines with low content are being put at work, and it is hoped that this will increase the offer of platinum; but the large dealers are persuaded that prices will not be reduced, as the demand is too high.

Palladium—Some sales of palladium are reported at $45@50 per oz., according to size and terms of order

Silver has advanced by sudden bounds about 1d. per oz., English standard, owing to the discovery that the stock in London was much less than expected. It is reported at about 7,000,000 oz. The higher price has brought out sellers and some reaction is probable should there be free selling at the advance.

Zinc and Lead Ore Markets

JOPLIN, MO.—Nov. 13

Blende, high price $118; base per ton 60% zinc, premium ore, $115; medium, $114@105; lower grades down to $100; Calamine base per ton 40% zinc, $80@70; average selling price, all grades of zinc, $101.24 per ton. Lead, high settling price $71.50, base per ton 80% metal content, $70@71; average selling price, all grades of lead, $67.84 per ton.

SHIPMENTS WEEK ENDED NOV. 27

	Blende	Calamine	Lead	Values
Totals this week.	15,262,560	3,048,140	1,760,310	$986,600
Total 11 months..	535,052,00	41,709,700	82,910,180	24,497,080

Blende value, the week, $820,110; 11 months, $21,227,610.

Calamine value, the week, $106,790; 11 months, $1,061,870.

Lead value, the week, $59,700; 11 months, $2,207,600.

The total shipment of 9,155 tons of zinc eclipses all previous records of sales, and is the strongest point marking the demand for zinc ore. The 4,000 tons stock at Granby is more than half gone and much of that remaining is sold for future delivery. Also a large portion of the Miami reserve has been sold and is being shipped. Elsewhere no large stocks have accumulated. Tonight the miners are threatening a strike if producers do not raise wages, but this is premature with many of the stronger companies which have a wage agreement based on the average base price of ore the preceding month.

PLATTEVILLE, WIS.—Nov. 27

The base price paid this week for zinc ore was $108@110 per ton for 60% grades. No sales of lead ore were reported.

SHIPMENTS, WEEK ENDED, NOV. 27

	Zinc Ore, Lb.	Lead Ore, Lb.	Sulphur Ore, Lb.
Week	6,076,000	.....	840,320
Year	189,643,750	6,338,640	26,534,310

Shipped during week to separating plants, 5,518,000 lb. zinc ore.

Iron Trade Review

NEW YORK—Dec. 1

The iron and steel markets continue to be extremely active, with heavy demand for both home consumption and export, while higher prices seem hardly to check the demand.

One exception to this is the withdrawal by the Pennsylvania R.R. of its order for 11,000 cars, on account of the high prices asked. In other cases, however, advances seem to make little difference, the rush being to secure material for delivery when needed. The export business is still a very large factor in the market.

Pig iron is quite as active as steel and prices are being firmly held at the advances made. Steel-making irons are in special demand with low-phosphorus also.

The statement comes from Philadelphia that the Replogle-Drexel syndicate has secured enough Cambria Steel stock in the market, in addition to that bought from the Pennsylvania R.R., to give them control of the company, and that plans for its reorganization will soon be brought forward. It is certain that there has been heavy buying of the outside stock.

PITTSBURGH—Nov. 30

Effective Dec. 1 the American Steel and Wire Co. is advancing wire products $2 a ton, making plain wire 1.85c. and wire nails $2 per keg, base. The general advancing tendency in steel prices is somewhat less pronounced. There is less pressure to place strictly new business, perhaps simply because early deliveries could not be secured, while there is heavier specifying on contracts.

A further quieting down in new buying is to be expected for December, while specifying on contract will doubtless be less active in the first quarter, on account of the higher range of contract prices, but the mills will enter the new year with nearly six months of solid work on their books, and there is no expectation in any quarter of any weakening whatever in the steel market for many months.

Lake Superior iron-ore prices for next year have not been closed and while an early announcement is expected in some quarters there is a contingent in favor of waiting until after Jan. 1 for the naming of prices.

Pig Iron—Pig-iron prices have been advancing very sharply, and all grades are quotable at $1 higher than a week ago. Apparently there is scarcely any unsold capacity for the next four or five months. We quote: Bessemer, $18@18.50; basic, $17; malleable and foundry, $17@17.50; forge, $16.50@17, f.o.b. Valley furnaces, 95c. higher delivered Pittsburgh.

Ferromanganese—The market has stiffened. Imported is firm at $100, seaboard, on contract, and domestic producers are firm at $110, shipping point, as minimum. Prompt lots go at $100@105 per ton.

Steel—The market is quiet as regular consumers have made private arrangements with their regular sources of supply and chance comers have no standing at all with producers who are indisposed to sell except when there is a direct obligation to take care of a regular customer. The market, such as there is, can be quoted at about $1 higher than a week ago: Bessemer billets, $28; bessemer sheet bars, $28@28.50; openhearth billets, $29@30; openhearth sheet bars, $29.50@30, f.o.b. maker's mill, Pittsburgh or Youngstown.

Chemicals

NEW YORK—Dec. 1

The general market is fairly steady, with few changes reported, and business inclined to be more active.

Arsenic—A moderate business is forward and little or no change is noted. Quotations are $3.75@4 per 100 lb. for both spot and futures.

Copper Sulphate—Business is quiet and on about the usual scale. Quotations are unchanged, at $8 per 100 lb. for carload lots and $8.25 per 100 lb. for smaller parcels.

Nitrate of Soda—Prices keep up well, though arrivals have been large. Quotations continue $2.90 per 100 lb. for December and $2.85 for later deliveries.

Pyrites—Imports at Baltimore for the week included 9,876 tons pyrites from Huelva, Spain.

Mining Companies—United States

Name of Company and Situation		Shares Issued	Par	Dividends Total	Latest	Amt.
Acacia, g.	Colo.	1,438,989	$ 1	$ 122,004	Jan '11	$0.01
Adams, s.l.c.	Colo.	80,000	10	778,000	Dec. '09	0.04
Ahmeek, c.	Mich.	50,000	25	3,175,000	Nov. '15	2.50
Alaska Mexican, g.	Alas.	180,000	5	3,507,381	Nov. '15	0.10
Alaska Treadwell, g.	Alas.	200,000	25	15,535,000	Nov. '15	0.50
Alaska United, g.	Alas.	180,200	5	1,991,210	Nov. '15	0.30
Am. Zinc, Lead & Sm.	U. S.	171,200	25	983,320	Jan. '14	0.50
Anaconda, c.	Mont.	2,496,250	50	100,073,125	Nov. '15	1.00
Argonaut, g.	Calif.	200,000	5	1,680,000	Sept. '15	0.06
Arizona Copper, pf.	Ariz.	1,426,120	1.20	2,127,043	Oct. '15	
Arizona Copper, com.	Ariz.	1,519,896	1.20	18,461,338	July '15	0.24
Bagdad-Chase, g., pf.	Calif.	184,819	5	202,394	Jan. '09	0.10
Baltic, c.	Mich.	100,000	25	7,950,000	Dec. '13	2.00
Bingham N. H., c.	Utah	228,690	5	454,302	Oct. '15	0.20
Bonanza Dev., g.	Colo.	300,000	1	1,425,000	Oct. '11	0.20
Brunswick, g.	Calif.	395,287	1	203,314	Sept. '15	0.06
Bunker Hill Con., g.	Calif.	200,000	1	865,000	Nov. '15	0.02½
Bunker Hill & Sul., l.s.	Ida.	327,000	10	16,609,500	Nov. '15	0.25
Butte-Alex Scott, c.	Mont.	74,000	10	159,100	Oct. '15	0.15
Butte-Ballaklava, c.	Mont.	250,000	10	125,000	Aug. '10	0.50
Butte & Superior, z.	Mont.	272,019	10	3,264,985	Sept. '15	5.75
Caledonia, l.s.c.	Ida.	2,605,000	1	650,300	Aug. '15	0.03
Calumet & Arizona, c.	Ariz.	617,385	10	22,176,828	Sept. '15	1.00
Calumet & Hecla, c.	Mich.	100,000	25	127,750,000	Sept. '15	15.00
Camp Bird, g.s.	Colo.	1,100,051	5	10,695,986	Nov. '15	0.24
Centen'l-Eur., l.s.g.c.	Utah	100,000	5	4,050,000	Apr. '14	1.50
Center Creek, l.z.	Mo.	100,000	10	550,000	Oct. '15	0.15
Champion, c.	Mich.	100,000	25	10,900,000	Nov. '15	2.00
Chief Consolidated, s.g.l.	Utah	871,384	1	306.821	Aug. '15	0.05
Chino, c.	New Mex.	869,940	5	5,828,015	Sept. '15	0.75
Cliff, g.	Utah	300,000	1	90,000	Jan. '13	0.10
Cliff, g.	Alas.	100,000	1	210,000	Oct. '13	0.01
Colo. Gold Dredging	Colo.	100,000	10	650,000	Sept. '14	1.00
Colorado, l.s.g.	Utah	1,000,000	0.20	2,570,000	Dec. '12	0.03
Columbus Con., g.s.	Utah	285,540	5	226,832	Oct. '07	0.20
Commercial Gold	Ore.	1,750,000	1	43,750	Dec. '10	0.00½
Con. Mercur, g.	Utah	1,000,000	1	3,445,313	July '13	0.03
Continental, z.l.	Mo.	22,000	25	341,000	July '15	0.50
Copper Range Con., c.	Mich.	393,739	100	13,986,746	Oct. '13	0.75
Daly Judge, s.l.	Utah	300,000	1	1,095,000	Oct. '15	0.25
Daly West, s.l.	Utah	180,000	20	6,606,000	Jan. '13	0.15
Doctor Jackpot, g.	Colo.	3,000,000	0.10	45,000	Mar. '11	0.00½
Doe Run, l.	Mo.	65,783	100	3,550,969	Dec. '13	0.76
Eagle & Blue Bell, g.s.l.	Utah	893,146	1	401,916	Aug. '15	0.10
Elkton Con., g.	Colo.	2,500,000	1	3,579,460	May '15	0.02
El Paso, g.	Colo.	490,000	5	1,707,545	Feb. '14	0.10
Ernestine, g.s.	N.M.	300,000	5	150,000	July '15	0.10
Fed. M. & S., com.	Idaho	60,000	100	2,708,750	Jan. '09	1.50
Fed. M. & S., pf.	Idaho	120,000	100	9,976,361	Sept. '15	1.00
Florence, g.	Nev.	1,050,000	1	840,000	Apr. '11	0.10
Frances-Mohawk, g.	Nev.	912,000	1	546,000	Jan. '08	0.05
Free Coinage, g.	Colo.	10,000	100	180,000	Dec. '09	1.00
Fremont Con., g.	Calif.	200,000	2.50	258,000	Oct. '14	0.02
Frontier, z.	Wis.	1,250	100	146,202	Nov. '13	2.00
Gemini-Key'ne, l.g.s.	Utah	5,000	100	2,305,000	Dec. '14	10.00
Gold Chain, g.	Utah	1,000,000	1	130,000	May '13	0.03
Gold Coin of Victor	Colo.	1,000,000	1	1,350,000	Feb. '09	0.02
Gold Dollar Con.	Colo.	2,500,000	0.10	100,000	Dec. '12	0.00½
Gold King Con., g.	Colo.	5,750,370	1	1,407,319	Dec. '11	0.03
Golden Cycle, g.	Colo.	1,500,000	1	4,200,000	Dec. '15	0.02
Golden Star, g.	Ariz.	400,000	5	140,000	Mar. '10	0.05
Goldfield Con., g.	Nev.	3,559,148	10	28,643,916	Oct. '15	0.10
Grand Central, g.	Utah	500,000	1	1,620,750	Sept. '14	0.05
Granite, g.	Colo.	1,650,000	1	270,000	Nov. '12	0.01
Hazel, g.	Cal.	900,000	1	971,000	Dec. '13	0.01
Hecla, l.s.	Idaho	1,000,000	0.25	3,655,000	Nov. '15	0.07
Hercules, l.s.	Idaho	1,000,000	1	5,725,000	June '15	
Homestake, g.	S. D.	251,160	100	38,457,494	Nov. '15	0.65
Horn Silver, l.s.z.	Utah	400,000	25	5,642,000	Sept. '07	0.05
Iowa, g.s.l.	Colo.	1,666,667	1	233,499	Aug. '14	0.00½
Iowa-Tiger, g.s.	Colo.	3,000	1	9,250	Dec. '14	1.00
Iron Blossom, s.l.g.	Utah	1,000,000	0.10	2,470,000	Oct. '15	0.05
Iron Silver, s.l.g.	Colo.	500,000	20	4,950,000	Dec. '14	0.10
Jamison, g.	Cal.	390,000	10	378,300	Jan. '11	0.02
Jerry Johnson, g.	Colo.	2,500,000	0.10	187,500	Nov. '14	0.01
Kendall, g.	Mont.	500,000	5	1,505,000	July '14	0.06
Kennedy, g.	Cal.	100,000	100	1,831,001	Apr. '10	0.03
King of Arizona, g.	Ariz.	200,000	1	396,000	Aug. '09	0.12
Klar Piquette, z.l.	Wis.	20,000	1	259,000	Apr. '13	0.50
Knob Hill, g.	Wash.	1,000,000	1	70,000	Oct. '13	0.00½
Liberty Bell, g.	Colo.	133,552	5	1,559,179	Sept. '13	
Little Bell, l.s.	Utah	300,000	1	75,000	Mar. '11	0.05
Little Florence, g.	Nev.	1,000,000	1	430,000	Jan. '08	0.03
Mammoth, g.s.c.	Utah	400,000	2.50	2,300,000	July '13	0.05
Mary McKinney, g.	Colo.	1,309,252	1	1,169,308	July '14	0.02
May Day, g.s.l.	Utah	800,000	0.25	244,000	Nov. '15	0.03
Mexican, g.s.	Nev.	201,600	2.50	161,910	June '14	0.75
Miami, c.	Ariz.	747,112	5	6,392,457	Nov. '15	1.00
Modoc, g.s.	Colo.	500,000	1	275,000	Dec. '11	0.01
Mohawk, c.	Mich.	100,000	25	3,575,000	Feb. '15	2.00
Monarch-Mad'a, g.s.l.	Colo.	1,000,000	1	40,000	May '11	0.01
Montana-Tonop., s.g.	Nev.	921,865	1	488,588	Dec. '12	0.10
Mountain, c.	Cal.	250,000	25	4,216,250	May '08	0.44
National, g.	Nev.	750,000	1	570,000	May '11	0.10
Nevada Con., c.	Nev.	1,999,457	5	18,976,141	Sept. '15	0.37½
New Century, z.l.	Mo.	330,000	1	237,600	Oct. '09	0.01
New Idria, q.	Cal.	100,000	5	1,730,000	Oct. '15	0.50
North Butte, c.	Mont.	430,000	15	12,277,000	July '15	0.40
North Star, g.	Cal.	250,000	10	4,687,040	Sept. '15	0.20
Old Domin'n, M. & Sm.	Ariz.	162,000	25	7,553,000	Sept. '15	1.50
Ophir, s.g.	Nev.	201,600	3	2,063,360	Jan. '12	0.10
Opohongo, g.s.l.	Utah	898,978	0.25	80,907	Jan. '13	0.02
Oroville Dredging	Cal.	700,000	5	1,771,838	Sept. '15	0.12
Osceola, c.	Mich.	96,150	25	12,900,800	Nov. '15	2.50
Parrot, c.	Mont.	229,850	10	7,871,839	July '15	1.63
Pearl Con., g.	Wash.	1,909,711	0.05	181,422	Dec. '10	0.02
Pharmacist, g.	Colo.	1,500,000	1	7,500	Feb. '10	0.00½
Pioneer, g.	Alas.	5,000,000	1	2,041,526	Oct. '11	0.03
Pittsburgh-Idaho, l.	Ida.	803,000	1	216,810	Oct. '12	0.04
Pittsburgh Silver Peak, g	Nev.	2,790,000	1	771,200	July '14	0.02
Portland, g.	Colo.	3,000,000	1	10,083,080	Oct. '15	0.02
Quilp	Wash.	1,500,000	1	67,500	Feb. '12	0.01

Mining Companies—United States—(*Continued*)

Name of Company and Situation		Shares Issued	Par	Dividends Total	Latest	Amt.
Quincy, c.	Mich.	110,000	$ 25	$21,447,500	Sept. '15	$2.00
Ray, c.	Ariz.	1,485,333	10	4,362,796	Sept. '15	0.37½
Republic, g.	Wash.	1,000,000	1	170,000	Nov. '12	0.01½
Rochester, l.z.	Mo.	4,900	100	190,846	July '12	0.50
Round Mountain, g.	Nev.	1,188,019	1	369,365	Aug. '13	0.04
Seven Troughs Coal., g.	Nev.	1,500,000	1	144,306	Sept. '15	0.02½
St. Joseph, l.	Mo.	1,472,252	10	9,925,530	Sept. '15	0.25
Shannon, c.	Ariz.	300,000	10	750,000	Jan. '13	0.50
Shattuck Arizona, c.	Ariz.	350,000	10	2,625,000	Aug. '15	0.50
Silver King Coal., l.s.	Utah	1,250,000	5	3,097,385	Oct. '15	0.15
Silver King Con., l.s.	Utah	627,582	1	748,096	Oct. '15	0.10
Sioux Con., s.l.g.	Utah	745,389	1	872,097	July '11	0.04
Skidoo, g.	Cal.	1,000,000	5	365,000	Oct. '14	0.01
Snowstorm, c.g.	Ida.	1,500,000	1	1,192,103	Oct. '13	0.02
South Eureka, g.	Calif.	299,981	1	411,680	July '15	0.03
Standard Con., g.s.	Cal.	178,394	10	5,274,407	Nov. '13	0.25
Stewart, s.l.	Ida.	1,238,362	1	1,950,396	Sept. '15	0.10
Stratton's Ind., g.	Colo.	1,000,000	0.60	456,625	Dec. '14	0.03
Success, z.	Ida.	1,500,000	1	1,020,000	Nov. '15	0.06
Superior & Pitts., c.	Ariz.	1,499,792	10	9,748,658	Sept. '15	0.38
Tamarack, c.	Mich.	60,000	25	9,420,000	July '07	4.00
Tennessee, c.	Tenn.	200,000	25	4,906,250	Oct. '15	0.75
Tomboy, g.s.	Colo.	310,000	4.85	3,709,395	June '15	0.24
Tom Reed, g.	Ariz.	909,555	1	2,443,757	Apr. '15	0.06
Tonopah Belm't, s.g.	Nev.	1,500,000	1	7,643,010	Oct. '15	0.12½
Tonopah Ext., g.s.	Nev.	943,433	1	967,016	Oct. '15	0.07½
Tonopah of Nev., s.g.	Nev.	1,000,000	1	13,000,000	Oct. '15	0.15
Tri-Mountain, c.	Mich.	100,000	25	1,450,000	Dec. '13	2.00
Tuolumne, c.	Mont.	800,000	1	520,000	May '13	0.10
Uncle Sam, g.s.l.	Utah	500,000	1	495,000	Sept. '11	0.05
United Cop. Min., c.	Wash.	1,000,000	1	40,000	Nov. '12	0.01
United (Crip. Ck.) g.	Colo.	4,000,100	1	440,435	Jan. '10	0.04
United Globe, c.	Ariz.	23,000	100	2,472,500	June '15	6.00
United Verde, c.	Ariz.	300,000	100	36,397,000	Nov. '15	0.75
Utah, s.l.	Utah	100,000	10	281,860	Dec. '10	0.02
Utah, c.	Utah	1,624,490	10	30,275,161	Sept. '15	1.00
Utah Con., c.	Utah	300,000	5	9,000,000	Sept. '15	0.50
Valley View, g.	Colo.	1,000,000	1	240,000	Dec. '10	0.04
Victoria, g.s.l.	Utah	250,000	1	207,500	Mar. '10	0.04
Vindicator Con., g.	Colo	1,500,000	1	3,217,500	Oct. '15	0.03
Wasp No. 2, g.	S. D.	500,000	1	544,466	Nov. '15	0.01
Wellington Mines, g.	Colo.	10,000,000	1	650,000	Nov. '15	0.02
Wolverine, c.	Mich.	60,000	25	8,520,000	Oct. '15	4.00
Yak, s.l.	Colo.	1,000,000	1	1,937,685	Sept. '15	0.03
Yankee Con., g.s.	Utah	1,000,000	1	167,500	Jan. '13	0.01
Yellow Aster, g.	Cal.	100,000	10	1,163,789	May '15	0.02
Yellow Pine, l.z.s.	Nev.	1,000,000	1	813,008	Nov. '15	0.07
Yukon Gold, g.	Alas.	3,500,000	5	7,350,000	Sept. '15	0.07½

Iron, Industrial and Holding Companies

Amalgamated, c.	Mont.	1,538,879	100	103,495,183	Aug. '15	$3.77
Am. Sm. & Ref., com.	U. S.	500,000	100	28,833,333	Sept. '15	1.00
Am. Sm. & Ref., pf.	U. S.	500,000	100	53,083,333	Sept. '15	1.75
Am. Smelters, pf. A.	U. S.	170,000	100	10,529,800	Oct. '15	1.50
Am. Smelters, pf. B.	U. S.	300,000	100	15,500,000	Oct. '15	1.25
Greene Cananea	U. S.	450,642	100	4,371,646	June '14	1.00
Guggenheim Expl.	U. S.	833,732	25	23,323,327	Oct. '15	1.00
Inter'l Nickel, com.	U. S.	380,315	100	23,408,834	Nov. '15	5.00
Inter'l Nickel, pfd.	U. S.	89,126	100	8,739,358	Nov. '15	1.50
National Lead, com.	N. Y.	206,554	100	8,890,632	Sept. '15	0.75
National Lead, pf.	N. Y.	243,676	100	30,545,959	Sept. '15	1.75
Old Dominion, c.	Ariz.	293,245	25	6,747,098	Sept. '15	1.50
Phelps, Dodge & Co.	U. S.	450,000	100	44,184,304	Sept. '15	5.50
U. S. Steel Corp., com.	U. S.	5,083,025	100	222,360,438	Dec. '14	0.50
U. S. Steel Corp., pf.	U. S.	3,602,811	100	389,503,012	Nov. '15	1.75
U. S. S., R. & M., com.	U.S.-Mex.	351,114	50	6,362,188	July '14	0.75
U. S. S., R. & M., pf.	U.S.-Mex.	486,348	50	16,369,693	Oct. '15	0.87½

Canadian, Mexican and Central American Companies

Ajuchitlan, g.s.	Mex.	50,000	$ 5	$ 212,500	Oct. '12	$0.25
Amparo, g.s.	Mex.	2,000,000	1	1,640,884	Nov. '15	0.03
B. C. Copper	B. C.	591,709	5	615,198	Jan. '13	0.15
Beaver Con., s.	Ont.	1,996,490	1	589,857	Oct. '15	0.03
Buffalo, s.	Ont.	1,000,000	1	2,757,000	July '14	0.03
Canadian Goldfields, g.	B. C.	600,000	0.10	290,000	July '14	0.001½
Chontalpan, g.s.l.z.	Mex.	7,000	25	59,500	May '14	0.75
Cobalt Townsite, s.	Ont.	45,000	1	1,042,259	May '14	0.10
Coniagas, s.	Ont.	800,000	5	7,720,000	Aug. '15	0.30
Con. M. & S. Co. of Can	B. C.	58,052	100	2,175,005	Oct. '15	2.00
Crown Reserve, s.	Ont.	1,768,814	1	6,067,030	July '15	0.02
Crow's Nest Pass C. Co.	B. C.	248,506	25	2,182,864	Mar. '11	0.25
Dos Estrellas, g.s.	Mex.	300,000	0.50	10,335,000	Dec. '13	1.50
El Oro, g.s.	Mex.	1,147,500	4.85	8,668,418	July '13	0.24
Esperanza, s.g.	Mex.	455,000	4.85	13,327,999	July '15	0.24
Granby, s.l.c.	B.C.	9,985	100	5,996,931	Nov. '15	1.50
Greene Con., c.	Mex.	1,000,000	10	9,544,400	May '14	0.50
Guanajuato D., pf., s.	Mex.	10,000	1000	274,356	Jan. '11	3.00
Hedley Gold	B. C.	120,000	10	1,704,000	Sept. '15	0.50
Hollinger, g.	Ont.	600,000	5	3,933,000	Nov. '15	0.20
Kerr Lake, s.	Ont.	600,000	5	5,970,000	Sept. '15	0.25
La Rose Con., s.	Ont.	1,498,627	5	6,014,588	Oct. '15	0.05
Le Roi No. 2, g.	B. C.	120,000	24.30	1,501,740	May '15	0.24
Lucky Tiger Com., g.	Mex.	715,337	10	3,253,391	Nov. '15	0.09
McK.-Dar. Sav. s.	Ont.	2,247,692	1	4,607,761	Oct. '15	0.03
Mines Co. of Am. (new)	Mex.	1,700,000	10	1,215,000	July '13	0.12½
N. Y. & Hond. Ros., g.	C. A.	200,000	10	3,790,000	Oct. '15	0.30
Nipissing, s.	Ont.	1,200,000	5	13,590,000	Oct. '15	0.25
Peñoles, s.l.g.	Mex.	80,000	25	6,361,688	June '13	1.25
Pinguico, pf., s.	Mex.	20,000	100	840,000	Oct. '13	3.00
Right of Way Mns, s.	Ont.	1,685,500	1	219,115	Nov. '14	0.02
Rio Plata, s.	Mex.	374,518	5	345,745	Feb. '13	0.05
San Rafael, g.s.	Mex.	2,400	25	1,442,380	Jan. '14	0.50
San Toy, g.s.	Mex.	5,750,000	1	530,000	July '13	0.01
Sorpresa, g.s.	Mex.	19,200	20	3,979,240	Jan. '11	34.00
Stand'd Silver-Lead.	B. C.	2,000,000	1	1,650,000	Nov. '15	0.02½
Temiskaming, s.	Ont.	2,500,000	1	1,384,155	Apr. '13	0.06
Tem. & Hud. Bay, s.	Ont.	7,761	1	1,940,250	Nov. '14	3.00
Trethewey, s.	Ont.	1,000,000	1	1,061,998	July '14	0.05
Wettlaufer-Lorrain, s.	Ont.	1,416,590	1	637,465	Oct. '13	0.05

Assessments

Company	Delinqe	Sale	Amt.
Blue Bull Reorg., Nev.	Nov. 1	Dec. 6	0.01
Clear Grit, Ida.	Dec. 14	Jan. 5	0.0015
Coeur d'Alene Inv., Ida.	Oct. 25	Dec. 6	0.002
Columbus Ext., Utah.	Dec. 11	Jan. 3	0.02
Confidence, Nev.	Dec. 24	Jan. 14	0.10
Cons. Imperial, Nev.	Nov. 30	Dec. 21	0.01
Copper Mt. M. & D., Ida.	Oct. 28	Dec. 1	0.002
Darby M. & M., Ida.	Nov. 16	Dec. 16	0.00125
Dry Canon Cons., Utah.	Dec. 18	Jan. 17	0.001
Emerald Oil, Utah	Nov. 27	Dec. 16	0.06
Eureka M. & M., Ida.	Nov. 26	Dec. 27	0.001
Great Western, Nev.	Nov. 15	Dec. 7	0.001
Hancock Cons., Mich.	Jan. 3		1.00
Hector, Ida.	Nov. 18	Dec. 10	0.005
Idaho & Los Angeles, Ida.	Nov. 26	Dec. 27	0.005
Idaho-Nevada Exp., Ida.	Nov. 1	Dec. 1	0.002
Idora, Ida., (post.)		Dec. 2	0.005
Ivanhoe, Ida.	Nov. 8	Dec. 9	0.0025
Jack Waite, Ida.	Nov. 20	Dec. 20	0.01
Laclede, Ida.	Dec. 6	Dec. 27	0.003
Leonora M. & M., Utah.	Nov. 27	Dec. 17	0.005
Lucky Swede, Ida.	Nov. 11	Dec. 11	0.002
Missoula Copper, Ida.	Nov. 15	Dec. 15	0.002
Montana Standard.	Nov. 15	Dec. 15	0.005
National Copper, Ida.	Nov. 20	Dec. 18	0.01
National Lead, Ida.	Nov. 15	Dec. 15	0.001
Nevada-Douglas, Nev.	Nov. 30	Dec. 31	0.10
New Arcadian, Mich.	Dec. 1		0.50
New Baltic, Mich.	Jan. 15		0.50
Northern Light, Ida.	Nov. 2	Dec. 2	0.004
O. K. Ex. M. & R., Utah.	Nov. 20	Dec. 15	0.005
Oom Paul Con., Ida.	Nov. 16	Dec. 6	0.01
Oreano, Ida.	Dec. 18	Jan. 18	0.001
Oriental, Nev.	Nov. 6	Dec. 7	0.003
Original, Nev.	Nov. 6	Dec. 7	0.003
Phedora, Ida., (post.)		Dec. 11	0.0005
Phoenix, Mich.	Jan. 1		1.00
Rescue Eula, Nev.	Dec. 6	Jan. 10	0.01
Seg. Belcher & Midas, Nev.	Dec. 12	Jan. 6	0.02
Silver Cliff, Ida.	Nov. 8	Dec. 6	0.0025
Sonora M. & M., Ida.	Nov. 4	Dec. 17	0.003
Sunset Dev., Ida.	Dec. 8	Jan. 3	0.002
Sunshine, Ida. (post.)		Dec. 15	0.0006
Ton. Gipsy Queen, Nev.	Oct. 29	Dec. 6	0.01
Tonopah Midway, Nev.	Dec. 11	Jan. 11	0.01
Umatilla Ton., Nev.	Nov. 8	Dec. 13	0.005
West Toleda, Utah	Dec. 16	Jan. 3	0.01
Wolf Mountain, Utah.	Nov. 12	Dec. 14	0.0025

Stock Quotations

Among sales at auction in Philadelphia on Nov. 24, we note 1 Shannon-Arizona R.R. 6% bond at $950. The stock of the Chile Copper Co. has been listed on the New York Stock Exchange.

COLO. SPRINGS	Nov. 30	SALT LAKE	Nov. 30
Name of Comp.	Bid.	Name of Comp.	Bid.
Acacia	.02⅜	Beck Tunnel	.06½
Cripple Cr'k Con.	.008	Black Jack	.07
C. K. & N.	‡.02	Colorado Mining	.08
Doctor Jack Pot.	.09¾	Crown Point	.01¾
Elkton Con.	.29	Daly-Judge	7.50
El Paso	.80	Emma Cop.	.23
Findlay	.03½	Gold Chain	.55
Gold Dollar	.02	Grand Central	.50
Gold Sovereign	.06¼	Iron Blossom	.95
Golden Cycle	1.84½	Lower Mammoth	.07½
Isabella	.18⅞	May Day	.17½
Jack Pot	.06⅜	Opohongo	.00½
Jerry Johnson	.05	Prince Con.	.81
Lexington	‡.005	Seven Troughs	.01⅜
Mary McKinney	.40	Silver King Coal'n.	3.45
Pharmacist	‡.008	Silver King Con.	2.25
Portland	1.72	Sioux Con.	.01⅜
Raven B. H.	.03	Uncle Sam	.07
Vindicator	1.74⅜	Yankee	.31½

TORONTO	Nov. 30		
Bailey	.04⅜	Dome Exten.	.28
Chambers Ferland	.22	Foley O'Brien	.50
Coniagas	5.15	Hollinger	27.50
Peterson Lake	.38	Imperial	.04
Right of Way	.05¾	Jupiter	.17½
Seneca Superior	.90	McIntyre	.96
Silver Queen	‡.01	Pearl Lake	‡.00½
T. & Hudson Bay	21.00	Porcu. Crown	.87
Timiskaming	.66½	Preston E. D.	.05
Trethewey	.18	Vipond	.78
Wettlaufer-Lor.	.11½	West Dome	.15½

SAN FRANCISCO	Nov. 30		
Alta	.08	Belmont	4.85
Andes	.09	Jim Butler	1.00
Best & Belcher	.05	Lone Star	.03
Caledonia	.40	MacNamara	.03
Challenge Con.	.06	Midway	.14
Chollar	‡.02	Mont.-Tonopah	.35
Confidence	.15	North Star	.17
Con. Virginia	.22	Rescue Eula	.08
Gould & Curry	.03	West End Con.	.80
Hale & Norcross	.04	Atlanta	.24
Jacket-Cr. Pt.	.15	Blue Bell	.03
Julia	‡.02	Booth	.42
Mexican	.33	C.O.D. Con.	.03
Occidental	.75	Comb. Frac.	.07
Ophir	.27	D'field Daisy	.03
Overman	.08	Jumbo Extension	1 22½
Potosi	‡.02	Pitts.-Silver Peak	.06
Savage	.05	Round Mountain	.41
Sierra Nevada	.46	Sandstorm Kendall	.09½
Union Con.	.57	Silver Pick	.05
Utah Con.	.03	Central Eureka	.06

N. Y. EXCH.	Nov. 30	BOSTON EXCH	Nov. 30
Name of Comp.	Clg.	Name of Comp.	Clg.
Alaska Juneau	10½	Adventure	2½
Am.Sm.&Ref.,com	99	Ahmeek	395
Am. Sm. & Ref., pf.	110½	Alaska Gold M.	25
Am. Sm. Sec., pf. A	90	Algomah	1¾
Am. Sm. Sec., pf. B.	85½	Allouez	56
Anaconda	88½	Am. Zinc	69¾
Batopilas Min.	2¾	Ariz. Com., ctfs.	7½
Bethlehem Steel	460	Bonanza	.35
Bethlehem Steel, pf.	160½	Butte-Ballaklava	3½
Chile Cop.	25⅞	Butte & Superior	73
Chino	54½	Calumet & Ariz.	68½
Colo. Fuel & Iron.	51⅝	Calumet & Hecla	568
Crucible Steel	74½	Centennial	16¾
Dome Mines	28½	Copper Range	58½
Federal M. & S., pf.	50⅜	Daly West	3¾
Great Nor., ore., ctf.	50	East Butte	15⅝
Greene Cananea	45½	Franklin	9½
Guggen. Exp.	78½	Granby	82
Homestake	121	Hancock	16¾
Inspiration Con.	45⅞	Hedley	29⅜
International Nickel	185	Helvetia	.40
Miami Copper	34½	Indiana	5⅜
Nat'l Lead, com.	65	Island Cr'k, com.	44½
National Lead, pf.	112	Island Cr'k, pfd.	89
Nev. Consol.	16⅞	Isle Royale	27
Ontario Min.	7⅜	Keweenaw	2⅞
Quicksilver	4	Lake	15½
Ray Con.	25⅛	La Salle	5½
Republic I&S, com.	51	Mason Valley	1½
Republic I&S, pf.	110	Mass	12⅜
Tennessee Copper	58	Mayflower	4
Utah Copper	79⅜	Michigan	2
U. S. Steel, com.	86⅛	Mohawk	87
U. S. Steel, pf.	115½	New Arcadian	9¾
		North Butte	31½
N. Y. CURB	Nov. 30	North Lake	2⅜
Alta Con.	.14	Ojibway	1⅜
Beaver Con.	.44	Old Colony	3
Big Four	.05	Old Dominion	58⅜
Braden Copper	16⅛	Osceola	84½
Buffalo Mines	1	Quincy	85
Can. Cop. Corpn.	1 1/16	Santa Fe	3⅜
Cashboy	.06½	Shannon	8
Cerro de Pasco	37½	Shattuck-Ariz.	34⅜
Con. Ariz. Sm.	1½	Superior	27
Con. Coppermines	1 1/16	Superior & Bost.	2½
Con. Nev.-Utah	1/16	Tamarack	52½
Dia. Black B.	.05	Trinity	10½
Florence	.37	Tuolumne	.36
Goldfield Con.	1½	U. S. Smelting	47½
Goldfield Merger	.18	U. S. Smelt'g, pf.	48⅜
Howe Sound	4	Utah Apex	3 7/16
Kennecott Cop.	53½	Utah Con.	12⅜
Kerr Lake	4⅜	Victoria	2½
La Rose	13/16	Winona	3½
Magma	15½	Wolverine	58½
McKinley-Dar-Sa.	.51	Wyandot	1⅜
Mines of Am.	3⅜		
Mother Lode	.31	BOSTON CURB	Nov. 30
Nevada Hills	.20	Bingham Mines	8½
New Utah Bingham	2⅞	Boston Ely	.39
Nipissing Mines	8⅛	Butte & Lon'n Dev.	.37
Oro	.06½	Calaveras	2
St. Joseph Lead	14½	Calumet-Corbin	.05
South Utah	.25	Chief Con.	1⅛
Stand'd Oil of N.J.	506	Cortez	.45
Standard S. L.	2	Crown Reserve	.63
Stewart	⅜	Davis-Daly	1⅜
Success	.60	Eagle & Blue Bell	1⅜
Tonopah	7	First Nat. Cop.	5 1/32
Tonopah Ex.	4	Houghton Copper	2⅛
Tonopah Merger	.60	Iron Cap Cop., pf.	7
Tribullion	⅛	Majestic	1½
Yukon Gold	2⅞	Mexican Metals	.37
		Nevada-Douglas	.82
LONDON	Nov. 18	New Baltic	3½
Alaska Tre'dwell	£6 17s 6d	New Cornelia	9½
Burma Corp.	1 11 3	Ohio Copper	.24
Cam & Motor	0 13 9	Oneco	1
Camp Bird	0 7 9	Raven Copper	.10
El Oro	0 10 0	Rex Cons.	.25
Esperanza	0 10 9	Smokey Dev.	.15
Mexico Mines	4 6 3	So. Lake	6½
Nechi, pfd.	0 12 6	Tonopah Victor	.35
Oroville	0 14 3	United Verde Ext.	4
Santa Gert'dis	0 10 6	Utah Metal	10
Tomboy	1 4 0		
Tough Oakes	0 9 0	‡Last Quotations.	

Monthly Average Prices of Metals

SILVER

Month	New York			London		
	1913	1914	1915	1913	1914	1915
January	62.938	57.572	48.855	28.983	26.553	22.731
February	61.642	57.506	48.477	28.357	26.573	22.753
March	57.870	58.067	50.241	26.669	26.788	23.708
April	59.490	58.519	50.250	27.416	26.958	23.709
May	60.361	58.175	49.915	27.825	26.704	23.570
June	58.990	56.471	49.034	27.199	25.948	23.267
July	58.721	54.678	47.519	27.074	25.219	22.597
August	59.293	54.344	47.163	27.335	25.979	22.780
September	60.640	53.290	48.680	27.986	24.260	23.591
October	60.793	50.654	49.385	28.083	23.199	23.925
November	58.995	49.082	51.714	27.263	22.703	25.094
December	57.760	49.375		26.720	22.900	
Year	59.791	54.811		27.576	25.314	

New York quotations cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

COPPER

Month	New York		London			
	Electrolytic		Standard		Electrolytic	
	1914	1915	1914	1915	1914	1915
January	14.223	13.641	64.304	60.756	69.488	65.719
February	14.491	14.394	65.259	63.494	70.188	*
March	14.131	14.787	64.276	66.152	69.170	*
April	14.211	16.811	64.747	75.096	69.313	*
May	13.996	18.506	63.182	77.600	67.786	*
June	13.603	19.477	61.336	82.574	66.274	95.333
July	13.223	18.796	60.540	76.011	64.955	91.409
August	*	16.941	‡	68.673	‡	82.333
September	*	17.502	‡	68.915	‡	85.250
October	*	17.686	‡	72.601	‡	88.000
November	11.739	18.627	53.227	77.744	*	93.273
December	12.801		56.841		*	
Year						

TIN

Month	New York		London	
	1914	1915	1914	1915
January	37.779	34.260	171.905	156.550
February	39.830	37.415	181.556	176.925
March	38.038	48.426	173.619	180.141
April	36.154	47.884	163.963	166.225
May	33.360	38.790	150.702	162.675
June	30.577	40.288	138.321	167.636
July	31.707	37.423	142.517	167.080
August	*	34.389	‡	151.440
September	32.675	33.125	‡	152.625
October	30.284	33.080	‡	151.554
November	33.304	39.224	139.391	167.670
December	33.601		147.102	
Av. year	34.301			

LEAD

Month	New York		St. Louis		London	
	1914	1915	1914	1915	1914	1915
January	4.111	3.729	4.011	3.548	19.665	18.606
February	4.048	3.827	3 937	3.718	19.606	19.122
March	3.970	4.053	3.850	3.997	19.651	21.883
April	3.810	4.221	3.688	4.142	18.225	21.094
May	3.900	4.274	3.808	4.182	18.503	20.347
June	3.900	5.932	3.810	5.836	19.411	25.170
July	3.891	5.659	3.738	5.531	19.051	24.611
August	3.875	4.656	3.715	4.520	‡	21.946
September	3.828	4.610	3.658	4.490	‡	23.151
October	3.528	4.600	3.384	4.499	‡	23.994
November	3.683	5.155	3.585	5.078	18.500	26.278
December	3.800		3.662		19.097	
Year	3.862		3.737			

SPELTER

Month	New York		St. Louis		London	
	1914	1915	1914	1915	1914	1915
January	5.262	6.386	5.112	6.211	21.533	30.844
February	5.377	8.436	5.228	8.255	21.413	39.819
March	5.250	8.541	5.100	8.366	21.460	44.141
April	5.113	10.012	4.963	9.837	21.569	49.888
May	5.074	14.781	4.924	14.610	21.393	68.100
June	5.000	21.208	4.850	21.038	21.345	100.614
July	4.920	19.026	4.770	18.856	21.568	97.250
August	5.568	12.781	5.418	12.611	‡	67.786
September	5.380	13.440	5.230	13.270	‡	67.841
October	4.909	12.800	4.750	12.596	‡	66.536
November	5.112	15.962	4.962	15.792	25.016	88.409
December	5.592		5.430		27.369	
Year	5.213		5.061			

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton. * Not reported, ‡ London Exchange closed.

PIG IRON IN PITTSBURGH

Month	Bessemer		Basic		No. 2 Foundry	
	1914	1915	1914	1915	1914	1915
January	$14.94	$14.59	$13.23	$13.45	$13.99	$13.90
February	15.06	14.55	14.12	13.45	14.08	13.90
March	15.07	14.55	13.91	13.45	14.10	13.95
April	14.90	14.55	13.90	13.45	14.13	13.95
May	14.90	14.61	13.90	13.60	14.27	13.83
June	14.90	14.70	13.90	13.67	13.96	13.77
July	14.90	14.94	13.90	13.91	13.90	13.68
August	14.90	16.01	13.90	15.31	14.08	14.75
September	14.90	16.86	13.90	15.95	14.03	15.70
October	14.84	16.95	13.75	15.96	13.97	15.80
November	14.59	18.26	13.43	17.30	13.83	17.20
December	14.70		13.45		13.83	
Year	$14.88		$13.78		$14.01	

The Mining Index

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COPPER

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2352—UTAH—The Disseminated Copper Ores of Bingham Canyon, Utah. J. J. Beeson. (Bull., A. I. M. E., Nov., 1915; 45 pp., illus.)

GOLD AND SILVER—GEOLOGY

2353—ALASKA—The Willow Creek District, Alaska. Stephen R. Capps. (Bull. 607, U. S. Geol. Surv., 1915; 86 pp., illus.)

2354—ARIZONA—Gold Deposits Near Quartzite, Arizona. Edward L. Jones, Jr. (Bull. 620-C, U. S. Geol. Surv., Sept. 23, 1915; 13 pp., illus.)

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GOLD DREDGING AND PLACER MINING

2358—ALASKA—The Willow Creek District, Alaska. Stephen R. Capps. (Bull. 607, U. S. Geol. Surv., 1915; 86 pp., illus.)

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GOLD AND SILVER—CYANIDING

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